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January 31, 2019

Ms. Rachel Freed
Deputy Regional Director
Bureau of Water Resources
Massachusetts Department of Environmental Protection
205 Lowell St
Wilmington, MA 01887

Subject: City of Boston – Revised Notice of Intent for the Muddy River Flood Damage Reduction Project (Phase 2)

Dear Ms. Freed:

On behalf of the City of Boston, CDM Smith Inc. (CDM Smith) prepared the following responses to comments received from the Massachusetts Department of Environmental Protection (MassDEP) on January 16, 2019. In addition, we have included a revised Notice of Intent (NOI) for the Muddy River Flood Damage Reduction Project (Phase 2). The revised NOI includes track changes to show revisions to the document as requested by MassDEP and discussed below.

MassDEP NOI Comments

Comment 1. *Alteration of BLSF is described in square feet only. The volume of fill (in cubic feet) should be listed (see tables for all the work areas).*

Response 1. The Phase 2 Project does not include any permanent fill in Bordering Land Subject to Flooding (BLSF). The work area tables presented in the NOI are complete with respect to impacts to this area. All temporary fill associated with construction access (as summarized in the Work Area tables) will also be removed.

Comment 2. *Documents referenced in the NOI must be attached (specifications for invasive species control; maintenance and management plan, etc.)*

Response 2. The Phase 2 Specifications by USACE were added to the Revised NOI as Appendix G. The Muddy River Restoration Project Maintenance and Management Plan was added to the Revised NOI as Appendix H.

Comment 3. *Potential flow diversion and water management issues related to contractor's means and methods should be discussed.*

Response 3. Further explanation regarding contractor requirements for this subject was added in Section 3.5 of the Revised NOI.

Additional Comments

Comment 4. *The NOIs should include a discussion of stormwater improvements that have been implemented since the Phase 1 work was conducted.*

Response 4. A discussion of stormwater improvements implemented by the non-federal sponsors was added to Section 4.0 in the Revised NOI.

Comment 5. *The discussion about how the project qualifies as an Ecological Restoration Project is incomplete because it does not address the habitat value of the existing phragmites and how the project will mitigate for that loss.*

Response 5. Further discussion of the habitat value of the existing phragmites and how the project will mitigate for that loss was added to Section 6.5.3 of the Revised NOI.

Comment 6. *The Invasives species management section of the NOI does not describe what action the Town and City will take once responsibility is passed to them.*

Response 6. In the Revised NOI, Section 5.3 was replaced with a new section, "Section 5.3 - Invasives Management After Construction."

Comment 7. *Section 6.0. Please clarify whether this section describes the Phase 2 project or Boston's proposed Pilot?*

Response 7. Section 6 describes the Phase 2 Project.

Comment 8. *Sections of the NOI narratives are taken from the 401 WQC application, sometimes verbatim, and sometimes with minor wording changes, or with the omission of paragraphs. The narrative portion of 401 WQC application is also attached to the NOIs (without the CD of Appendices), recommends that the 401 WQC be removed from the NOIs. Pertinent sections of the 401 application can be references in the NOIs without attaching the entire document, thus avoiding future conflicts or confusions.*

Response 8. Appendix B, Water Quality Certification Application by U.S. Army Corps of Engineers (USACE), was removed from the Revised NOI.



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Comment 9. *All references to the City of Boston's invasive species "Pilot Project" NOI should be removed from the Phase 2 NOIs.*

Response 9. In the Revised NOI, "Section 5.3 Invasives Management – Pilot Program" was removed, along with any other references to the pilot program in the NOI.

Please do not hesitate to contact me at (617) 452-6586 or via email if you have any questions or concerns.

Sincerely,

A handwritten signature in blue ink that reads "Robert Button". The signature is fluid and cursive, with the first and last names being the most prominent.

Robert O. Button, P.E.
Vice-President
CDM Smith Inc.

cc: Thomas Brady, Town of Brookline
Amelia Croteau, City of Boston
Margaret Dyson, City of Boston
Jennifer Flanagan, Corps of Engineers, New England District



NOTICE OF INTENT

Muddy River Flood Damage Reduction Project (Phase 2)

City of Boston

Parks and Recreation
Department

October 2018 *(Revised January 2019)*



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Project Narrative

1.0 Introduction

The City of Boston is submitting this Notice of Intent (NOI) for the Phase 2 Muddy River Flood Damage Reduction Project (the Project) as an Ecological Restoration Limited Project. The Project has been designed by the U.S. Army Corps of Engineers-New England District (ACOE) and aims to relieve the Muddy River of flooding, improve degraded riverine habitats, poor water quality, and other related water resource problems.

The construction of the Muddy River project requires the expertise of two different types of contractors. For this reason, the design and implementation of the project was conducted in two separate phases. The first phase consisted of the major structural features of the flood control improvements, daylighting of two sections (about 700 linear feet) of the Muddy River, and sediment removal from the Upper Fens Pond. Construction of Phase 1 began in 2013 and was substantially completed in August 2016. The work completed in Phase 1 included:

- Constructed 10' by 24' concrete culverts under both the Riverway and Brookline Avenue.
- Removed existing twin 72" pipes in the Old Sears Parking Lot and daylighted the river in this area.
- Removed existing twin 72" pipes in Brookline Avenue jug handle area and in the area just upstream of Avenue Louis Pasteur culvert. Daylighted the river in these two areas.
- Reconstructed culvert opening at upstream end of Avenue Louis Pasteur culvert.
- Dredged and reshaped the Upper Fens Pond section of the river to allow for increased flow.
- Installed temporary flow restriction structure upstream of the Riverway.
- Landscaping with trees, shrubs, and emergent plantings.
- Installed habitat logs and boulders for fish and turtles.
- Post construction vegetation monitoring and invasive species control.

The second phase of the Muddy River Flood Damage Reduction Project consists of removal of sediment for flow conveyance in the Fens, Riverway, and Leverett Pond. Phase 2 is proposed to begin construction during Spring of 2019, and will include the following work:

- Excavate the river in the Back Bay Fens area to allow for increased flows and reduce flood damage.

- Excavate five stretches of the Riverway section of the river to allow for increased flows and reduce flood damage.
- Excavate the sandbar and island at Leverett Pond to allow for increased flows and reduce flood damage.
- Excavate deepened channel sections to delay need for maintenance dredging.
- Provide additional flood proofing at the Boston Fire Department Fire Control Center in the Back Bay Fens.
- Management of invasives (Phragmites) in the Back Bay Fens and Riverway areas where necessary to achieve and maintain flood damage reduction and improve ecological habitat quality.
- Restore wetland vegetation in dredged areas by seeding or planting appropriate wet meadow and emergent wetland plants.
- Restore riparian vegetation in upland areas where Phragmites or Japanese knotweed are eradicated by planting grass, trees and shrubs.
- Installation of habitat logs for fish and turtles.
- Removal of the temporary flow restriction structure upstream of the Riverway.
- Restore vegetation and other landscape features following removal of temporary access roads, staging areas, and the flow restriction structure.
- Post construction vegetation monitoring and invasive species control.

All of this work will serve to further the interests of the Wetlands Protection Act (WPA) by restoring and improving the natural capacity of the Muddy River wetlands resource areas in accordance with the goals of an Ecological Restoration Limited Project.

~~In addition to the work proposed by the USACE, the City of Boston is also in the process of permitting an invasives management pilot program for pre-work in areas to be addressed by the USACE Phase 2 project and for areas impacted by invasives but not included within the USACE project. The invasives management pilot program will include work in the Riverway and Back Bay Fens segments of the Muddy River. The invasives management pilot program is consistent with the overall project goals of restoring the Muddy River's wetlands resources and the natural capacity of these resource areas to protect and sustain the interests identified in the WPA. This pilot program is also being permitted as an Ecological Restoration Limited Project as discussed in greater detail below.~~

The project has several objectives that serve to restore and protect the interests of the WPA (as noted in parentheses below):

- 1) Alleviate flooding along the river corridor and reduce flood damage to public and private property (flood control and storm damage prevention);

- 2) Improve the water quality of the river by restoring river hydraulics and removing contaminated sediments in dredged areas (prevention of pollution and protection of fisheries);
- 3) Restore shoreline plantings to increase plant species diversity and structural diversity to the riparian plant community compared to existing conditions (protection of wildlife habitat).

The objectives listed above serve to restore and protect five of the eight interests of the WPA and to satisfy related General Eligibility Criteria for Inland Ecological Restoration Limit Projects.

The dredging component of the project will improve the interests of flood control and storm damage prevention, as well as the wildlife habitat and fisheries interests in the Back Bay Fens and Riverway segments for areas impacted by construction as shown on the project documents. Removal of the contaminated river sediments will reduce a source of pollution and limit potential recontamination of downstream areas in the future, thus supporting the prevention of pollution interest. Restoration of the riparian plant community (in areas impacted by construction) will improve the wildlife habitat of the banks compared to existing conditions. Removal of the Phragmites stands (in areas impacted by dredging) within the river in the Fens and Riverway will improve habitat value of land underwater and bank areas. In addition, removal of phragmites in bank, BVW, and buffer zone areas through ~~either the Phase 2 project or the invasives management pilot program~~ will further the desired ecological restoration benefits.

The proposed work was developed to achieve the flood control benefits and to fulfill the requirements for an inland Ecological Restoration Limited Project (Other Category) including:

- Thinning or Planting of Vegetation to Improve Habitat Value;
- Fill Removal and Re-grading;
- Flow Restoration; and
- Invasive Species Management.

Written notices regarding the proposed Phase 2 project for work in both Boston and Brookline were submitted to the Massachusetts Environmental Policy Act (MEPA) Office, ~~along with the written notice for the invasives management pilot program in Boston~~, for publication in the Environmental Monitor (on October 10, 2018) in advance of the hearings held by the Boston Conservation Commission and the Brookline Conservation Commission on the Notices of Intent filed for the respective projects/jurisdictions.

Waters in the Muddy River are currently classified as Class B according to the Massachusetts Department of Environmental Protection (MA DEP) by park rules, Class B waters are considered acceptable for bathing and other recreational purposes, protection and propagation of fish, other aquatic life and wildlife, and after adequate treatment, for use as water supplies. In addition, the Muddy River has been classified as a warm water fishery. Massachusetts Class B standards require a minimum dissolved oxygen (DO) concentration of 5.0 mg/l for warm water fisheries, pH in the range of 6.5 to 8.0 standard units or as naturally occurring, fecal coliform not to exceed 200

colonies/100 ml, and color, turbidity, and suspended solids in concentrations that would exceed the recommended limits of the most sensitive receiving water use. Also, Class B waters shall be free of floating oils, grease, petrochemicals, and pollutants that form objectionable deposits or nuisances.

Water quality of the Muddy River is controlled by numerous factors including:

- 1) Flow regime of the lower Muddy River (i.e., flat gradient of the river and non-varying backwater elevation controlled by Charles River Dam;
- 2) Organic loading from storm drains, illegal sewer connections, and combined sewers;
- 3) Other pollutant loads (nutrients, heavy metals, oils, floatables) from storm drains and combined sewers;
- 4) Sediment oxygen demand (SOD);
- 5) Release of nutrients from anaerobic sediment;
- 6) Organic loading from extensive submergent and emergent (Phragmites) vegetation, and leaf fall from deciduous trees and shrubs;
- 7) Waste geese and ducks; and
- 8) Overland loading of sediment and nutrients from surrounding park lands and erosion from unprotected shoreline.

Mathew et al. (2011) determined that nutrient loading from algae, sediment, and waterfowl dominate the spatial pattern of water quality in the Muddy River. The study concluded that significant improvement in dissolved oxygen, biological oxygen demand, and total phosphorus could be expected from the sediment removal component of the Muddy River restoration project.

Sediment from Leverett Pond, the Riverway, and Fens contain elevated levels of metal, PAHs, petroleum hydrocarbons, and PCBs. PCBs and DDT and its metabolites are also frequently detected. Concentrations of contaminants are generally highest in surface sediments and decline with depth. Accumulation of contaminants in sediment is believed to be the result of years of loading from storm drains, combined sewer overflows, point source discharges (fuel oil), and atmospheric deposition (dust and precipitation). Conditions are exacerbated by the highly urbanized nature of the watershed, sluggish nature of the Muddy River and resulting lack of significant flushing, and low dissolved oxygen levels which slow decomposition of petroleum hydrocarbons and other organic contaminants.

Multiple lines of evidence indicate that chemicals in Muddy River sediment pose a risk to biota (see Appendix F in USACE (2003)). Sediment is likely to adversely affect fish and benthic invertebrates. Principal lines of evidence in support of this assessment are comparison with probable effect concentrations (PECs) developed by McDonald et al. (2000) and bioassay test results. Levels of metals, PAHs, pesticides and PCBs in sediment from Leverett Pond, the

Riverway, and Back Bay Fens generally exceed PECs. In many cases, PECs are exceeded several fold, making adverse impacts on benthic invertebrate communities probable.

Community types (habitat) in the Muddy River study area were mapped by USACE (2003). The entire Muddy River study area includes about 40 acres of wetland habitat and 120 acres of upland habitat. As natural areas linked together in a highly urbanized setting, Jamaica Park, Olmsted Park comprised of Wards Pond, Spring Pond, the Babbling Brook, Willow Pond and Leverett Pond, the Riverway, and the Back Bay Fens provide extremely valuable wildlife habitat in a local landscape context. The parks are also valuable on a wider scale, because of linkage with the Arnold Arboretum to the south through Jamaica Park, and proximity to Franklin Park to the east and the Charles River Basin to the north. The most valuable wildlife habitat is the wooded habitat in the vicinity of Wards and Willow Pond, islands and riparian habitat at the southern end of Leverett Pond, naturalized areas along the Riverway, and wooded riparian habitat along the Upper Fens pool.

Numerous birds, mammals, amphibians, and reptiles are known to occur in the Back Bay Fens and vicinity (see USACE, 2003). The area supports resident (breeding) populations of many bird species and provides a valuable refuge for songbirds, wading birds, and waterfowl migrating through the Boston area. A large population of ducks, mostly black duck/ mallard hybrids, is present in the Riverway and Back Bay Fens throughout the year. Canada goose are also abundant. Painted turtle, snapping turtle, and red eared sliders (a non-native species) are common in the Fens. Fish likely to be present in the project area include Common carp, golden shiner, bluegill, brown bullhead, and goldfish. Common carp, and to a lesser extent the other dominant species are tolerant of periodic exposure to low dissolved oxygen concentrations. Blueback herring have been known to occur in Muddy River since the 1990's and were observed in the river during Phase 1 construction. Spawning habitat in the Muddy River is thought to be located at the southern end of Leverett Pond near the discharge of Babbling Brook. Freshwater mussels including the common eliptio (*Elliptio complanata*) are abundant. The Phase 2 Project Area is not mapped as priority habitat of rare species or estimated habitat of rare wetlands wildlife (MA NHESP, 2017). No Federally-listed species occur in the study area.

Plant communities along the Muddy River originate from plantings made in the 1890's during construction of the Emerald Necklace parks. Plans called for planting a great variety of trees, shrubs, and herbaceous species (see Zaitzevsky, 1982). However, much of the intended design has been lost over the years due to the growth of native and non-native "volunteers". Extensive stands of *Phragmites* are present in the Riverway and Back Bay Fens. Although *Phragmites* is native to the northeastern United States, studies indicate that all native New England varieties have been supplanted by a highly invasive Eurasian variety (Saltonstall, 2002). *Phragmites* varieties occurring in the Muddy River were studied by Keller (2000). *Phragmites* is present along embankments up to several feet above the above the normal water elevation. *Phragmites* growth in the project area is robust with *Phragmites* constricting the river channel in numerous locations.

The following sections describe the ecological restoration activities proposed in each of the wetlands resource areas to meet the projects restoration goals following completion of the Phase 2 work. The activities within wetlands resource areas are presented for each work area within Leverett Pond, the Riverway and the Back Bay Fens segments as proposed by the USACE. The

combined benefits to the ecological restoration of wetlands resource areas from the both the Phase 1 Project, the proposed Phase 2 are also presented below. ~~In addition, the invasives management program is described in greater detail for the work proposed in the City of Boston.~~

2.0 Summary of Work in Wetlands

The proposed Muddy River Flood Damage Reduction Project - Phase 2 includes dredging, ecological restoration (for areas impacted by construction) and flood proofing work in the following wetlands resource areas:

- Bank;
- Bordering Vegetated Wetlands (BVW);
- Land Under Water (LUW); and
- Buffer Zone.

In addition to these resource areas, the project also includes work in Bordering Land Subject to Flooding (BLSF) and Riverfront Area. The proponent has submitted Notices of Intent to the local conservation commissions to permit the project as an Ecological Restoration Limited Project that provides flood control and ecological restoration benefits through improvements to the above wetland resource areas along with invasive species management and pollution prevention as discussed below.

3.0 Description of the Proposed Project by River Segment

3.1 Introduction

The following sections describe the proposed activities within thirteen work areas associated within the three geographic segments of the Flood Damage Reduction Project - Phase 2 (i.e. Leverett Pond, the Riverway and the Back Bay Fens). These sections describe the:

- Existing conditions of each work area/segment;
- Functions and values or “interests” supported within each work area/segment;
- Proposed work and impacts;
- Proposed construction methods and staging areas; and
- Proposed construction monitoring and mitigation measures.
- The construction methods, staging areas, monitoring and proposed mitigation measures for all work areas are presented herein.

The impacts to wetlands resource areas within each work area are presented for the respective work within each municipality. In addition to the proposed mitigation measures described herein, Section 3 describes the Benefits, Impacts and Restoration plan for the project.

3.2 Leverett Pond (Work Area No. 1) Boston and Brookline

The majority of work within wetland resource areas in Leverett Pond will occur within Land Under Water (in Boston and Brookline) for dredging, Inland Bank and Bordering Vegetated Wetland for restoration/ enhancement of areas impacted by construction (in Brookline) and buffer zone for restoration of construction access and staging areas (also in Brookline). This work will not adversely affect the principal functions and values of the pond. No loss of Inland Bank or BVW will occur as a result of this work.

The following sections describe the existing conditions and interests supported by the resource areas in Leverett Pond. Impacts, construction monitoring and proposed mitigation are discussed in Section 3.5.

3.2.1 Existing Conditions and Interests of the Act

Just upstream of the Riverway section of the Muddy River is Leverett Pond which is a shallow 7-acre pond with a maximum depth of 5 to 6 feet. The pond receives inflow from Willow Pond (Babbling Brook), the Daisy Field drain, Village Brook, and numerous smaller storm drains. The tributary area to the Village Drain is approximately 2,060 acres, the largest tributary area for storm water outfalls to the Muddy River. Material discharged from the Village Brook Drain has formed an extensive shoal area and an exposed sediment deposit near its outlet at the northern end of the pond.

Leverett Pond is bordered by grassed parkland along most of its perimeter. There is an earthen bank on the Boston side (east) and a gabion formed shoreline for the majority of the Brookline side (west). Roadways surround Leverett Pond and include Route 9 (to the north), The Jamaica Way (to the east), Willow Pond Road (to the south) and Pond Avenue (to the west). Leverett Pond contains three islands along its western edge. The land that is immediately adjacent to Leverett Pond consists of vegetated woodlands and grassy parklands with paved and unpaved paths. Beyond the woodlands and to the east is the Jamaica Way and to the west is Pond Avenue, which separates the residential areas from Leverett Pond.

The normal water surface elevation during dry-weather flow in Leverett Pond is approximately elevation 18 feet (Boston City Base), which is the same elevation as the downstream portions of the Muddy River and the Charles River.

3.2.2 Description of Work in Resource Areas and Impacts

The proposed Phase 2 project includes removal of sediment and the exposed sediment deposit in the vicinity of the Village Brook Drain and the outlet of the Pond. Approximately 5,350 cubic yards of materials will be removed. The proposed work in Leverett Pond will serve to protect and sustain the interests identified in the WPA and meet the general eligibility criteria for an inland Ecological Restoration Limited Project. Dredging in Leverett Pond will improve the capacity of the resource areas in Leverett Pond to protect fish habitat (protect fisheries) and provide pollution prevention along with storm damage protection and flood control benefits.

The following tables summarize the resource area impacts for each work area and municipality.

Table 1 Work Area No. 1 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land Under Water	25,245	sq.ft.
Excavation: Land Under Water	4,457	cy
Dredge Area (Length)	222	lf
Dredge Area (Width)	30 to 160	lf
Dredge Area (Depth)	2.5 to 7	lf
Alteration of Land Under Water	25,245	sq.ft.
Bordering Land Subject to Flooding ⁽²⁾	143,630	sq.ft.

Table 2 Work Area No. 1 – Town of Brookline

Resource Impact (1)	Quantity	Units
Excavation: Land Under Water	5,058	sq.ft.
Excavation: Land Under Water	893	cy
Dredge Area (Length)	222	lf
Dredge Area (Width)	30 to 160	lf
Dredge Area (Depth)	2.5 to 7	lf
Temporary Fill (Access)	203	sq.ft.
Temporary Fill (Access)	508	cy
Alteration of Bank	37	Lf
Alteration of Bordering Vegetated Wetland	203	sq.ft.
Alteration of Land Under Water	5,058	sq.ft.
Bordering Land Subject to Flooding (2)	179,697	sq.ft.

3.3 The Riverway (Work Area Nos. 2 through 6) Boston and Brookline

Wetland resources in the Riverway include Land Under Water (LUW), Inland Bank, discrete patches of Bordering Vegetated Wetland (BVW), Bordering Land Subject to Flooding (BLSF), and Riverfront Area (RFA). The RFA extends 25 feet horizontally from the river to the east (on the Boston side) and 200 feet horizontally on the west (Brookline side) of the river. The proposed work in the Riverway will serve to protect and sustain the interests identified in the WPA and meet the general eligibility criteria for an inland Ecological Restoration Limited Project. The Phase 2 project will improve the capacity of the resource areas in the Muddy River to provide flood control and prevent storm damage, while the removal of contaminated sediments and environmental restoration (in areas impacted by construction) will protect/improve the interests of pollution prevention, fisheries, and wildlife habitat.

The following sections describe the existing conditions and interests supported by the resource areas in the Riverway. Impacts, construction monitoring and proposed mitigation are discussed in Section 3.5.

3.3.1 Existing Conditions and Interests of the Act

The Riverway section of the Muddy River flows north from Leverett Pond for about 1 mile to Park Drive. Width of river ranges from about 20 to 120 ft., and averages about 40 feet. Water surface area is about 6.5 acres. Mean depth is about 1.5 feet, and maximum depth is 6.5 ft. based on a 1997 USGS survey. Flow is sluggish and elevation through the reach drops only about six inches. Outflow is also influenced by water level in the Charles River Basin, which is controlled by operation of the Charles River Dam. The historic downstream boundary was located at Brookline Avenue, before a 350 ft. segment was filled for construction of the Sears parking lot. The filled section was daylighted during Phase 1, and the Riverway now ends at the newly installed 10' by 24' culvert under Park Drive.

There was a need to provide a flow restriction after construction of the Phase 1 culverts such that flood flows higher than existing conditions are not discharged into the Fens prior to completion of the Phase 2 dredged channel that is located downstream of these culverts. In 2015, a contractor for the Army USACE installed a flow restriction control structure (FRCS) as part of Phase 1 construction. The structure is sheet pile dam with rectangular weir openings and stop logs located just upstream of the 10 x 24 Riverway culvert (Photograph x). The structure maintains flow equivalent to the capacity of the former two 6-foot diameter culverts that conveyed flow to the Fens area downstream. The FRCS will be removed after completion of the Phase 2 flood control channel in the Back Bay Fens and flood proofing of the Boston Fire Department – Fire Control Center.

The “Riverway” comprises a linear park along both sides of the Muddy River and consists of a maintained grassy parkland with paved and unpaved paths, and a mixture of mature Olmsted-planted trees, and younger volunteer trees and shrubs.

The Massachusetts Department of Conservation and Recreation (MassDCR) maintained Riverway parkway runs parallel along the River’s east side (Boston) with the Massachusetts Bay Transportation Authority (MBTA) Green Line tracks running along the west side (Brookline) until Netherlands Road where local Brookline streets are encountered. Riparian vegetation is well developed along some sections of the river. In others, turf with some tree cover is often maintained nearly to the river’s edge. The Riverway contains three islands along its length, all designed by Olmsted. The largest, Riverwalk Island, is accessible by footbridge.

The Riverway contains a number of stormwater outfalls. The largest are Huntington Avenue Drain, which discharges on the Boston side of the Muddy River, and Tannery Brook Drain, and the Longwood Avenue Drain, both of which are located in Brookline.

Considerable lengths of the bank are either eroding and/or being undercut by stormwater runoff and river flow. The channel is protected by riprap immediately downstream of the Route 9 bridge. The Town of Brookline has recently installed coir fiber rolls to control bank erosion downstream of the Longwood Avenue Bridge.

Many areas of the Riverway have shoaled significantly since it was last dredged in 1963. Sediments from storm drains, accumulation of poorly decomposed organic material, encroachment by Phragmites, and streambank erosion all contribute to the problem. The channel

is completely or nearly completely blocked by Phragmites in several areas, including upstream of Park Drive near the flow restriction control structure and at the Riverwalk Island.

3.3.2 Description of Work in Resource Areas and Impacts

The majority of work in the Riverway (i.e. area of alteration) involves dredging Land Under Water to remove accumulated sediment and eradicating Phragmites growing within the river channel (within the proposed work areas as shown on the drawings). The entire bank exhibits erosion at the water line, however, stabilization of the bank is only proposed within the limits of work/access.

Five areas with flow restrictions due to shoaling and sedimentation are proposed in areas impacted by work/access.

The five work areas in the Riverway section include:

- Area Two - upstream from Brookline Avenue;
- Area Three – on the Boston side of the Riverwalk Island;
- Area Four – downstream of Netherlands Road;
- Area Five is located about 900 ft. downstream from the Longwood Avenue bridge; and
- Area Six is at the downstream end of the Riverway where Phase 2 will connect to the Phase 1 improvements and flow restriction control structure (FRCS) will be removed.

Sediment excavated from these areas will likely be excavated in the dry, additionally dewatered if required, and tested for transportation to final disposal. Sediment removal in work Area 6 includes removal of a large area of Phragmites, which cannot be hydraulically dredged. Phragmites is also present in Work Areas 2, 3, and 4. The FRCS, constructed as part of Phase 1 construction, will be removed after completion of the Phase 2 flood control channel in the Back Bay Fens and flood proofing of the Boston Fire Department – Fire Control Center.

Not only does removal of accumulated sediment and Phragmites improve water conveyance preventing flooding, it provides significant ecological restoration benefits. Benthic substrate quality is improved for invertebrate colonization which become a food source for fish, including anadromous fish. Improving water flow minimizes stagnation that can lead to depressed oxygen, increased temperatures, nutrient concentrations, and algal blooms. Dredging will improve fish habitat (protect fisheries) and provide pollution prevention along with storm damage protection and flood control benefits in accordance with the general eligibility criteria for ecological restoration limited projects.

The following tables summarize the resource area impacts for each work area and municipality.

Table 3 Work Area No. 2 - City of Boston

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	17,242	sq. ft.
Excavation: Land under water	2,704	cy
Excavation: Bordering vegetated wetland	4,945	sq. ft.
Excavation: Bordering vegetated wetland	275	cy
Dimension of dredge area (Length)	877	lf.
Dimension of dredge area (Width)	20 to 65	lf.
Dimension of dredge area (Depth)	2.5 to 5	lf.
Area of BVW Restored (Emergent Veg)	3,577	sq. ft.
New Habitat Shelf (Non-Vegetated)	0	sq. ft.
Fill (wetland topsoil installed under water)	1,675	sq. ft.
Fill (stone installed under water)	0	sq. ft.
Temporary Fill (Access)	9,659	sq. ft.
Fill (wetland topsoil installed under water)	93	cy
Fill (stone installed under water)	0	cy
Temporary Fill (Access)	24,148	cy
Total area of Phragmites	4,034	sq. ft.
Total area of Phragmites Removed	4,034	sq. ft.
Total area of Phragmites Remaining	0	sq. ft.
Alteration — bank	576	lf.
Alteration — BVW	10,299	sq. ft.
Alteration — Land under water	17,242	sq. ft.
Riverfront (0 -25 ft.)	25,764	sq. ft.
Riverfront Area Disturbed	5,488	sq. ft.
Bordering land subject to flooding	53,214	sq. ft.

Table 4 Work Area No. 2 – Town of Brookline

Resource Impact (1)	Quantity	Units
Excavation: Land under water	10,038	sq. ft.
Excavation: Land under water	1,574	cy
Excavation: Bordering vegetated wetland	3,215	sq. ft.
Excavation: Bordering vegetated wetland	179	cy
Dimension of dredge area (Length)	877	lf.
Dimension of dredge area (Width)	20 to 65	lf.
Dimension of dredge area (Depth)	2.5 to 5	lf.
Area of BVW Restored (Emergent Veg)	2,725	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	-	cy
Total area of Phragmites	3,495	sq. ft.
Total area of Phragmites Removed	3,495	sq. ft.
Total area of Phragmites Remaining	3,495	sq. ft.
Alteration - bank	595	lf.
Alteration - BVW	3,215	sq. ft.
Alteration – Land under water	10,038	sq. ft.
Riverfront (0 -100 ft.)	80,000	sq. ft.
Riverfront (100 – 200 ft.)	78,000	sq. ft.
Riverfront Area Disturbed	6,801	sq. ft.
Bordering land subject to flooding	307,645	sq. ft.

Table 5 Work Area No. 3 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	13,698	sq. ft.
Excavation: Land under water	877	cy
Excavation: Bordering vegetated wetland	8,594	sq. ft.
Excavation: Bordering vegetated wetland	477	cy
Dimension of dredge area (Length)	447	lf.
Dimension of dredge area (Width)	20 to 90	lf.
Dimension of dredge area (Depth)	2 to 4	lf.
Area of BVW Restored (Emergent Veg)	1,599	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	3,514	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	8,785	cy
Total area of Phragmites	7,689	sq. ft.
Total area of Phragmites Removed	7,689	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	279	lf.
Alteration - BVW	11,104	sq. ft.
Alteration – Land under water	13,698	sq. ft.
Riverfront (0 -25 ft.)	16,225	sq. ft.
Riverfront Area Disturbed	3,949	sq. ft.
Bordering land subject to flooding	34,366	sq. ft.

Table 6 Work Area No. 3 – Town of Brookline

Resource Impact (1)	Quantity	Units
Excavation: Land under water	4,430	sq. ft.
Excavation: Land under water	284	cy
Excavation: Bordering vegetated wetland	2,088	sq. ft.
Excavation: Bordering vegetated wetland	116	cy
Dimension of dredge area (Length)	447	lf.
Dimension of dredge area (Width)	20 to 90	lf.
Dimension of dredge area (Depth)	2 to 4	lf.
Area of BVW Restored (Emergent Veg)	913	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	-	cy
Total area of Phragmites	1,668	sq. ft.
Total area of Phragmites Removed	1,668	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	-	lf.
Alteration - BVW	2,088	sq. ft.
Alteration – Land under water	4,430	sq. ft.
Riverfront (0 -100 ft.)	50,300	sq. ft.
Riverfront (100 – 200 ft.)	80,300	sq. ft.
Riverfront Area Disturbed	7,159	sq. ft.
Bordering land subject to flooding	30,506	sq. ft.

Table 7 Work Area No. 4 - City of Boston

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	4,573	sq. ft.
Excavation: Land under water	375	cy
Excavation: Bordering vegetated wetland	-	sq. ft.
Excavation: Bordering vegetated wetland	-	cy
Dimension of dredge area (Length)	160	lf.
Dimension of dredge area (Width)	35 to 45	lf.
Dimension of dredge area (Depth)	1.5 to 3.5	lf.
Area of BVW Restored (Emergent Veg)	604	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	945	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	2,363	cy
Total area of Phragmites	-	sq. ft.
Total area of Phragmites Removed	-	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	80	lf.
Alteration - BVW	-	sq. ft.
Alteration – Land under water	4,573	sq. ft.
Riverfront (0 -25 ft.)	5,329	sq. ft.
Riverfront Area Disturbed	1,271	sq. ft.
Bordering land subject to flooding	62,981	sq. ft.

Table 8 Work Area No. 4 – Town of Brookline

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	2,007	sq. ft.
Excavation: Land under water	165	cy
Excavation: Bordering vegetated wetland	-	sq. ft.
Excavation: Bordering vegetated wetland	-	cy
Dimension of dredge area (Length)	160	lf.
Dimension of dredge area (Width)	35 to 45	lf.
Dimension of dredge area (Depth)	1.5 to 3.5	lf.
Area of BVW Restored (Emergent Veg)	416	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	-	cy
Total area of Phragmites	-	sq. ft.
Total area of Phragmites Removed	-	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	-	lf.
Alteration - BVW	-	sq. ft.
Alteration – Land under water	2,007	sq. ft.
Riverfront (0 -100 ft.)	41,800	sq. ft.
Riverfront (100 – 200 ft.)	71,400	sq. ft.
Riverfront Area Disturbed	-	sq. ft.
Bordering land subject to flooding	298,421	sq. ft.

Table 9 Work Area No. 5 - City of Boston

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	5,771	sq. ft.
Excavation: Land under water	515	cy
Excavation: Bordering vegetated wetland	2,755	sq. ft.
Excavation: Bordering vegetated wetland	153	cy
Dimension of dredge area (Length)	130	lf.
Dimension of dredge area (Width)	30 to 80	lf.
Dimension of dredge area (Depth)	2.5 to 5	lf.
Area of BVW Restored (Emergent Veg)	1,282	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	272	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	680	cy
Total area of Phragmites	8,076	sq. ft.
Total area of Phragmites Removed	2,475	sq. ft.
Total area of Phragmites Remaining	5,601	sq. ft.
Alteration - bank	133	lf.
Alteration - BVW	3,116	sq. ft.
Alteration – Land under water	5,771	sq. ft.
Riverfront (0 -25 ft.)	4,615	sq. ft.
Riverfront Area Disturbed	2,106	sq. ft.
Bordering land subject to flooding	69,468	sq. ft.

Table 10 Work Area No. 5 – Town of Brookline

Resource Impact (1)	Quantity	Units
Excavation: Land under water	-	sq. ft.
Excavation: Land under water	-	cy
Excavation: Bordering vegetated wetland	-	sq. ft.
Excavation: Bordering vegetated wetland	-	cy
Dimension of dredge area (Length)	130	lf.
Dimension of dredge area (Width)	30 to 80	lf.
Dimension of dredge area (Depth)	2.5 to 5	lf.
Area of BVW Restored (Emergent Veg)	-	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	-	cy
Total area of Phragmites	9,746	sq. ft.
Total area of Phragmites Removed	-	sq. ft.
Total area of Phragmites Remaining	9,746	sq. ft.
Alteration - bank	-	lf.
Alteration - BVW	-	sq. ft.
Alteration – Land under water	-	sq. ft.
Riverfront (0 -100 ft.)	31,600	sq. ft.
Riverfront (100 – 200 ft.)	75,800	sq. ft.
Riverfront Area Disturbed	-	sq. ft.
Bordering land subject to flooding	176,834	sq. ft.

Table 11 Work Area No. 6 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	32,785	sq. ft.
Excavation: Land under water	4,777	cy
Excavation: Bordering vegetated wetland	11,568	sq. ft.
Excavation: Bordering vegetated wetland	643	cy
Dimension of dredge area (Length)	420	lf.
Dimension of dredge area (Width)	60 to 175	lf.
Dimension of dredge area (Depth)	4 to 8	lf.
Area of BVW Restored (Emergent Veg)	3,018	sq. ft.
New Habitat Shelf (Non-Vegetated)	620	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	3,790	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	9,475	cy
Total area of Phragmites	22,234	sq. ft.
Total area of Phragmites Removed	22,234	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	448	lf.
Alteration - BVW	12,193	sq. ft.
Alteration – Land under water	32,785	sq. ft.
Riverfront (0 -25 ft.)	16,202	sq. ft.
Riverfront Area Disturbed	5,716	sq. ft.
Bordering land subject to flooding	99,428	sq. ft.

Table 12 Work Area No. 6 – Town of Brookline

Resource Impact (1)	Quantity	Units
Excavation: Land under water	14,630	sq. ft.
Excavation: Land under water	2,132	cy
Excavation: Bordering vegetated wetland	4,739	sq. ft.
Excavation: Bordering vegetated wetland	263	cy
Dimension of dredge area (Length)	420	lf.
Dimension of dredge area (Width)	60 to 175	lf.
Dimension of dredge area (Depth)	4 to 8	lf.
Area of BVW Restored (Emergent Veg)	1,350	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	3,548	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	8,870	cy
Total area of Phragmites	10,216	sq. ft.
Total area of Phragmites Removed	10,216	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	212	lf.
Alteration - BVW	4,739	sq. ft.
Alteration – Land under water	14,630	sq. ft.
Riverfront (0 -100 ft.)	41,200	sq. ft.
Riverfront (100 – 200 ft.)	60,400	sq. ft.
Riverfront Area Disturbed	10,274	sq. ft.
Bordering land subject to flooding	352,025	sq. ft.

3.4 The Back Bay Fens (Work Areas 7-13) Boston

Wetland resources in the Back Bay Fens include Land Under Water, Inland Bank, Bordering Vegetated Wetlands (BVW), Bordering Land Subject to Flooding (BLSF) and Riverfront Area (RFA), as well as the 100-foot buffer zone to Inland Bank and BVW. The RFA extends 25 feet horizontally from the river bank in Boston. The proposed work in the Back Bay Fens will also serve to protect and sustain the interests identified in the WPA and meet the general eligibility criteria for an inland Ecological Restoration Limited Project. The Phase 2 project will improve the capacity of the resource areas in the Muddy River to provide flood control and prevent storm damage, while the removal of contaminated sediments and environmental restoration (in areas

impacted by construction) will protect/improve the interests of pollution prevention, fisheries, and wildlife habitat.

The following sections describe the existing conditions and interests supported by the resource areas in the Back Bay Fens followed by a discussion of impacts, construction monitoring and proposed mitigation are discussed at the end of the section.

3.4.1 Existing Conditions and Interests of the Act

The Back Bay Fens (or Fens) section of the Muddy River is located between the Riverway and the Charlesgate section. The Fens is all that remains of the 750-acre Back Bay of the Charles River which was filled in the mid-nineteenth century. The area was modified by Olmsted in the 1890's to become part of the Emerald Necklace. The Fens, as envisioned by Olmsted, has been greatly altered over the last century. The area was a tidal marsh until about 1910 when a dam created the Charles River Basin and all but eliminated tidal influence. The park was substantially redesigned in the early 20th century but retained vital flood control functions and defining features from the Olmsted period. Various other endeavors encroached upon open water and intruded on parklands through the 1970's.

The total existing water surface area of the Fens today is about 20 acres, including 1.6 acres restored by daylighting during Phase 1. This area includes about 7 acres of emergent wetland, most of which is vegetated with Phragmites. Water depth generally ranges from 2 to 4 feet. The Muddy River flows from the lower fens to the Charlesgate section of the river, where it enters the Charles River Basin through a submerged conduit. Flow is sluggish, and the water level is influenced by water level in the Charles River Basin, which is controlled by operation of the Charles River Dam. A great deal of sediment has also accumulated in the Back Bay Fens.

Historic aerial imagery indicates most of the emergent Phragmites wetland has developed since 1951 (Figure 5-1). Phragmites is discussed in more detail in Section 5.

The Back Bay Fens is surrounded by park land. Public facilities near the river include the Victory Gardens, Boston Fire Department Fire Control Center, Mothers Rest Playground, athletic fields, the Agassiz Road (Longfellow) Duck House, the Kelleher Rose garden, Veterans Memorial Park, several monuments or memorials, and walking and biking paths. Parkland restored during Phase 1 is known as the Justine Mee Liff Park. The area is also near many institutions, including the Museum of Fine Arts (Boston), Emmanuel College, Simmons College, Isabella Stewart Gardner Museum, Massachusetts College of Art and Design, Wentworth Institute of Technology, Northeastern University, the Berklee Conservatory, and Fenway Park. Several of these significant institutions sustained damage from flooding.

Prior to construction of Phase 1, the Back Bay Fens included two sections where the original river channel was filled and the river piped through twin 6-ft. diameter culverts. These areas were located under the former Sears parking lot opposite the Landmark Center and between the former Upper Fens Pond and the Avenue de Louis Pasteur Bridge. Phase I removed the 6-ft. diameter culverts and restored about 800 ft. of river, an island, and associated parkland and riparian habitat. The restored river flows through 10 x 24 ft. culverts at Park Ave and Brookline Avenue. Phase 1 also removed several thousand cubic yards of sediment from the Upper Fens.



1951



2017

Figure 1 - Aerial Imagery of Back Bay Fens – 1951 and 2017.

Pond and sediment in the stone arch culvert under the Avenue Louis Pasteur Bridge. Banks in day lighted and restored areas were protected with stone and geocells and extensive planting.

Several shallow water “shelves” were installed along the banks and planted with emergent vegetation under the Phase 1 project. Created and restored riparian habitat was planted with native shrubs, trees, and ferns according to a plan developed by a historic landscape architect, consistent with Olmsted’s vision and species palette.

3.4.2 Description of Work in Resource Areas and Impacts

Work areas 7 through 12 are located in the Back Bay Fens and run together continuously from Avenue Louis Pasteur to Boylston Street. Sediment excavated from these areas may be excavated in the wet or dry dependent on water depth and other physical characteristics of the work area, additionally dewatered if required, and tested for transportation to final disposal. Some sediment removal in the Back Bay Fens includes removal of large area of Phragmites, which cannot be hydraulically dredged.

Work Area 13 is located at the Boston Fire Department (BFD) – Fire Control Center near the corner of Fenway and Agassiz Road. The USACE’s Decision Document noted that 100-yr flood protection will be required for the BFD site. The 100% design submittal details protection measures which include a floodwall topped with identical to existing security fencing with lighting and an interior underground pre-cast concrete storm water pumping station to convey storm water runoff within the Fire Department property when flood waters in the Muddy River prevent gravity storm water flow from the property.

The purpose of the work in the Back Bay Fens is primarily to improve the flood control function and provide environmental restoration in areas of the Muddy River impacted by the Phase 2 construction. Approximately 71,000 cubic yards of dredging is proposed for flood control.

Table 13 Work Area No. 7 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	43,237	sq. ft.
Excavation: Land under water	5,326	cy
Excavation: Bordering vegetated wetland	3,111	sq. ft.
Excavation: Bordering vegetated wetland	173	cy
Dimension of dredge area (Length)	655	lf.
Dimension of dredge area (Width)	50 to 190	lf.
Dimension of dredge area (Depth)	1.5 to 7	lf.
Area of BVW Restored (Emergent Veg)	2,875	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	4,529	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	6,595	sq. ft.
Fill (wetland topsoil installed under water)	252	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	16,488	cy
Total area of Phragmites	11,437	sq. ft.
Total area of Phragmites Removed	11,437	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	331	lf.
Alteration - BVW	3,111	sq. ft.
Alteration – Land under water	43,237	sq. ft.
Riverfront (0 -25 ft.)	38,178	sq. ft.
Riverfront Area Disturbed	7,101	sq. ft.
Bordering land subject to flooding	177,769	sq. ft.

Table 14 Work Area No. 8 - City of Boston

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	36,002	sq. ft.
Excavation: Land under water	4,900	cy
Excavation: Bordering vegetated wetland	116	sq. ft.
Excavation: Bordering vegetated wetland	6	cy
Dimension of dredge area (Length)	668	lf.
Dimension of dredge area (Width)	40 to 50	lf.
Dimension of dredge area (Depth)	2.5 to 6	lf.
Area of BVW Restored (Emergent Veg)	1,313	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	6,204	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	15,510	cy
Total area of Phragmites	-	sq. ft.
Total area of Phragmites Removed	-	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	81	lf.
Alteration - BVW	203	sq. ft.
Alteration – Land under water	36,002	sq. ft.
Riverfront (0 -25 ft.)	36,270	sq. ft.
Riverfront Area Disturbed	2,799	sq. ft.
Bordering land subject to flooding	177,769	sq. ft.

Table 15 Work Area No. 9 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	33,895	sq. ft.
Excavation: Land under water	5,860	cy
Excavation: Bordering vegetated wetland	451	sq. ft.
Excavation: Bordering vegetated wetland	25	cy
Dimension of dredge area (Length)	665	lf.
Dimension of dredge area (Width)	25 to 70	lf.
Dimension of dredge area (Depth)	1 to 6	lf.
Area of BVW Restored (Emergent Veg)	2,029	sq. ft.
New Habitat Shelf (Non-Vegetated)	-	sq. ft.
Fill (wetland topsoil installed under water)	-	sq. ft.
Fill (stone installed under water)	2,070	sq. ft.
Temporary Fill (Access)	5,061	sq. ft.
Fill (wetland topsoil installed under water)	-	cy
Fill (stone installed under water)	230	cy
Temporary Fill (Access)	12,653	cy
Total area of Phragmites	-	sq. ft.
Total area of Phragmites Removed	-	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	209	lf.
Alteration - BVW	622	sq. ft.
Alteration – Land under water	33,895	sq. ft.
Riverfront (0 -25 ft.)	41,798	sq. ft.
Riverfront Area Disturbed	1,007	sq. ft.
Bordering land subject to flooding	263,980	sq. ft.

Table 16 Work Area No. 10 - City of Boston

Resource Impact ⁽¹⁾	Quantity	Units
Excavation: Land under water	178,236	sq. ft.
Excavation: Land under water	32,797	cy
Excavation: Bordering vegetated wetland	8,690	sq. ft.
Excavation: Bordering vegetated wetland	483	cy
Dimension of dredge area (Length)	1,499	lf.
Dimension of dredge area (Width)	30 to 260	lf.
Dimension of dredge area (Depth)	0.5 to 10	lf.
Area of BVW Restored (Emergent Veg)	11,246	sq. ft.
New Habitat Shelf (Non-Vegetated)	745	sq. ft.
Fill (wetland topsoil installed under water)	662	sq. ft.
Fill (stone installed under water)	2,050	sq. ft.
Temporary Fill (Access)	25,224	sq. ft.
Fill (wetland topsoil installed under water)	37	cy
Fill (stone installed under water)	228	cy
Temporary Fill (Access)	63,060	cy
Total area of Phragmites	64,548	sq. ft.
Total area of Phragmites Removed	64,548	sq. ft.
Total area of Phragmites Remaining	-	sq. ft.
Alteration - bank	1,290	lf.
Alteration - BVW	8,751	sq. ft.
Alteration – Land under water	178,236	sq. ft.
Riverfront (0 -25 ft.)	76,356	sq. ft.
Riverfront Area Disturbed	18,833	sq. ft.
Bordering land subject to flooding	302,982	sq. ft.

Table 17 Work Area No. 11 - City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	90,999	sq. ft.
Excavation: Land under water	9,652	cy
Excavation: Bordering vegetated wetland	23,881	sq. ft.
Excavation: Bordering vegetated wetland	1,327	cy
Dimension of dredge area (Length)	956	lf.
Dimension of dredge area (Width)	40 to 150	lf.
Dimension of dredge area (Depth)	0.5 to 9.5	lf.
Area of BVW Restored (Emergent Veg)	5,814	sq. ft.
New Habitat Shelf (Non-Vegetated)	2,116	sq. ft.
Fill (wetland topsoil installed under water)	997	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	38,681	sq. ft.
Fill (wetland topsoil installed under water)	55	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	96,703	cy
Total area of Phragmites	91,841	sq. ft.
Total area of Phragmites Removed	58,939	sq. ft.
Total area of Phragmites Remaining	32,902	sq. ft.
Alteration - bank	844	lf.
Alteration - BVW	24,928	sq. ft.
Alteration – Land under water	90,999	sq. ft.
Riverfront (0 -25 ft.)	53,065	sq. ft.
Riverfront Area Disturbed	8,329	sq. ft.
Bordering land subject to flooding	202,551	sq. ft.

Table 18 Work Area No. 12 – City of Boston

Resource Impact (1)	Quantity	Units
Excavation: Land under water	79,624	sq. ft.
Excavation: Land under water	10,748	cy
Excavation: Bordering vegetated wetland	8,869	sq. ft.
Excavation: Bordering vegetated wetland	493	cy
Dimension of dredge area (Length)	847	lf.
Dimension of dredge area (Width)	75 to 140	lf.
Dimension of dredge area (Depth)	1.5 to 9	lf.
Area of BVW Restored (Emergent Veg)	7,414	sq. ft.
New Habitat Shelf (Non-Vegetated)	1,446	sq. ft.
Fill (wetland topsoil installed under water)	1,486	sq. ft.
Fill (stone installed under water)	-	sq. ft.
Temporary Fill (Access)	20,758	sq. ft.
Fill (wetland topsoil installed under water)	83	cy
Fill (stone installed under water)	-	cy
Temporary Fill (Access)	51,895	cy
Total area of Phragmites	88,659	sq. ft.
Total area of Phragmites Removed	50,524	sq. ft.
Total area of Phragmites Remaining	38,135	sq. ft.
Alteration - bank	844	lf.
Alteration - BVW	8,869	sq. ft.
Alteration – Land under water	79,624	sq. ft.
Riverfront (0 -25 ft.)	44,948	sq. ft.
Riverfront Area Disturbed	11,017	sq. ft.
Bordering land subject to flooding	166,169	sq. ft.

Work Area No. 13 – City of Boston

The USACE Decision Document noted that 100-yr flood protection will be required for the Boston Fire Department (BFD) – Fire Control Center, located near the corner of Fenway and Agassiz

Road. The 100% design submittal details protection measures which include a floodwall topped with identical to existing security fencing with lighting and an interior underground pre-cast concrete storm water pumping station to convey storm water runoff within the Fire Department property when flood waters in the Muddy River prevent gravity storm water flow from the property. The pump station is a 7,000-gallon pre-cast concrete tank with twin 10 HP storm water pumps and a double catch basin frame and grate set at an elevation slightly above the elevation of gravity flow from the site. As floodwaters rise, a check valve in the gravity outflow pipe will prevent floodwater from backing into the site and the pump station will begin taking water and pumping.

The work at the BFD – Fire Control Center will include activities in the 100-foot Wetlands Buffer Zone as well as within Bordering Land Subject to Flooding (BLSF).

3.5 Construction Methods, Staging Areas, Monitoring and Mitigation (All Work Areas)

The Phase 2 100% permit package (Drawings [in Appendix F](#) and Specifications [in Appendix G](#)) submitted with this application describe the layout of the flood control channel, access, and storage areas, pedestrian and hauling routes, utility investigations and relocations, site restoration, construction sequencing, environmental protection, including measures to protect Blueback herring and sensitive areas within the park system, flood protection for the Boston Fire Department – Fire Control Center in the Back Bay Fens, and traffic management. The package also includes sediment quality information and quantity estimates of material to be excavated. The 100% permit package includes revisions based on comments received on the 95% design from the Town of Brookline, the City of Boston, Massachusetts Division of Marine Fisheries, Massachusetts DCR, and the Massachusetts DEP. The Muddy River Management and Maintenance Oversight Committee, Emerald Necklace Conservancy, and other stakeholders also provided comments.

Additional revisions to the Drawings and Specifications may be required upon receipt of Water Quality Certification from the Massachusetts DEP and Orders of Conditions from the Town of Brookline and City of Boston.

The Construction Contractor will be required to provide various submittals that will further describe means and methods, environmental protection, and construction sequencing. Some of the submittals will be provided to the MADEP and other agencies for review, others will be reviewed only by USACE.

Permitting is based on the current plans and specifications included in Appendix F and Appendix G. If the Contractor requests a change to the means and methods during construction, including for flow diversion and water management issues, the Contractor will need to return to the local Conservation Commissions and/or MassDEP for consideration. The Contractor is responsible for the time and costs associated with the permitting efforts related to these requests.

Submittals will include, but are not limited to, the following:

<u>Specification Section</u>	<u>Description of Submittal</u>
01 57 20	Environmental Protection Plan
01 57 20	Surface Water and Wastewater Quality Monitoring Plan

01 57 20	Fish (Blueback Herring) Truck and Transport Plan (if needed)
31 00 00	Dewatering Work Plan
31 00 00	Excavation Work Plan
32 93 00	Restoration Work Plan
32 94 00	Invasive Species Control Work Plan

For a complete list of submittals see Specification Section 01 33 00 [in Appendix G](#).

The proposed method of sediment removal is primarily mechanical however either mechanical or hydraulic dredging is allowed within Leverett Pond. Other work areas are better suited for mechanical dredging as opposed to hydraulic dredging for several reasons. First, the existing channel is very shallow in some areas as well as narrow in others which prohibit even the smallest hydraulic dredge on a barge from accessing. Secondly, all sections of Muddy River exist in a highly urban environment where debris of all kinds ends up in the river which will clog or repeatedly disable hydraulic dredge equipment. This debris was observed during low flow periods and includes natural debris such as downed trees and limbs, stones, and layers of leaf litter mixed with brush as well as a large quantity of man-made debris including construction debris, tires, metal parts, safe doors, shopping carts, bicycles, bottles, cans and other household refuse, vehicle parts, and plastic. Third, hydraulic dredging cannot be used for *Phragmites* excavation and upland banks areas where channel slopes require cutting into uplands. Lastly, hydraulic dredging will require somewhat extensive staging, including access areas for dewatering presses, pump lines, frac tanks, and sludge handling areas. Given the location of the project within a major metropolitan city and park area, these staging and access areas are extremely limited.

Hydraulic dredging was required for the non-federal dredging of the Charlesgate Section of Muddy River, from Boylston Street to the Charles River prior to the USACE Phase 1 construction. After the contract was awarded, it was quickly determined hydraulic dredging was impossible due to many of the issues discussed above. The contract was modified to allow mechanical dredging and the portion of the project was completed with that method.

Mechanical dredging was used within Upper Fens Pond in Phase I during the Spring/Summer of 2015. The flow within Upper Fens Pond was diverted around the work area, the area was then sectioned off using steel sheet pile walls and dewatered to excavate in the dry. The material was mixed in-situ with sawdust, loaded onto trucks and hauled to final disposal. A temporary access road was constructed along one river bank by excavating organic sediment to a more stable base and then using a 3" minus gravel as a temporary road base for excavators and site dump trucks. As the excavators backed out of the channel, the temporary road was shaped, some of the material removed, and slope stabilization installed.

The contractor may determine that dredging in the wet with specialized equipment may be more beneficial to work around fish windows or the sensitive nature of existing features within the park system. Working in the wet would minimize dewatering of aquatic habitat and stranding of turtles, fish, freshwater mussels, and other aquatic life. It would, however, require measures such as siltation curtains to isolate the work area and protect water quality.

Based on these considerations, the Leverett Pond work area, including the sand island, may be hydraulically dredged with small equipment on a barge and pumped onshore due to ample water access and depth for a small dredge. This material is predominately sand so excavation in the wet is a viable option as well. The sediment removed from this area may be dewatered using

Geotubes or a filter press along the edge of the pond and then transported to a disposal site. Depending on the dewatering method, the water may require additional turbidity treatment prior to being returned to the river.

Two of the five Riverway work areas are upstream from Brookline Avenue, one is located on the Boston side of the Riverwalk Island, the fourth is located about 900 ft. downstream from the Longwood Avenue bridge, and the fifth is at the downstream end of the Riverway. Sediment excavated from these areas will likely be excavated in the dry, additionally dewatered if required, and tested for transportation to final disposal. Sediment removal in work Area 6 includes removal of a large area of Phragmites, which cannot be hydraulically dredged. Phragmites is also present in Work Areas 2, 3, and 4. The flow restriction control structure (FRCS), constructed as part of Phase 1 construction, will be removed after completion of the Phase 2 flood control channel in the Back Bay Fens.

Work areas 7 through 12 are located in the Back Bay Fens and run together continuously from Avenue Louis Pasteur to Boylston Street. Sediment excavated from these areas may be excavated in the wet or dry dependent on water depth and other physical characteristics of the work area, additionally dewatered if required, and tested for transportation to final disposal. Some sediment removal in the Back Bay Fens includes removal of large area of Phragmites, which cannot be hydraulically dredged.

Not only does removal of accumulated sediment and Phragmites improve water conveyance preventing flooding, it provides significant ecological restoration benefits. Benthic substrate quality is improved for invertebrate colonization which become a food source for fish, including anadromous fish. Improving water flow minimizes stagnation that can lead to depressed oxygen, increase temperatures and nutrient concentrations and algal blooms. See section 5 for a more detail description on the additional benefits associated with sediment removal.

Sequence of each individual work area is detailed in the notes on the “Sequencing, Dewatering, Staging & Access Plans” (GC101 thru GC105). Additionally, “Hauling Plans” (GC106 thru GC108) detail allowable hauling routes in and out of the work areas. It is likely that multiple crews will be required to complete the project within the intended 3-year construction window while working around the environmental (blueback herring migration) windows. The contractor will be required to submit a work plan that will be reviewed as part of the best value contract. Actual sequence of work will be reviewed at that time however the 100% plans and specifications allow contractor flexibility with their own means and methods to meet the 3-year construction duration.

Because the work will occur in a larger urban environment, there is very little open space available for staging in the vicinity of the project site except for the adjacent park land. Proposed staging and access areas are shown on the Drawings. The areas shown provide for truck and equipment access ways and storage locations, minimal material storage, and locations for dewatering equipment, if used. Existing gravel and paved walkways were used to access work areas to the maximum extent. Little or no tree clearing is required for staging and access to adjacent roadways. Tree root zones were avoided as much as possible. Where vehicular travel underneath tree canopy was unavoidable, root zones will be protected from soil compaction.

A meeting was held with USACE, MA DCR, City of Boston, Town of Brookline, and the MA State Police to discuss construction related hauling of the excavated material. Police details will be required during hauling activities for trucks entering and exiting designated work areas.

Proposed hauling routes are shown on the “Hauling Plans” (GC106-GC108). Plans also include provisions for allowing pedestrian and bicycle traffic to safely bypass work areas. Work areas will be fenced during construction and during establishment of turf and landscape planting. Fencing is shown on construction and landscaping plans.

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor will construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the contract drawings and specifications. BMPs may include, but not be limited to, vegetation cover, slope stabilization, silt fences, and straw wattles. Any temporary measures shall be removed after the area has been stabilized. The project will be covered by a NPDES Construction General Permit. The construction contractor will submit an Environment Protection Plan for USACE approval before construction begins.

- Project plans propose to conduct most of the construction in the dry. Work areas will either be entirely dewatered, with flow maintained by a bypass pumping system or flow will be diverted from one side of the river to the other. Normal flow above Park Drive is estimated to be 6 cfs. Water diversion systems will be designed to pass displaced flows without exceeding 6 inches of river level change upstream or downstream of diversions at all times.
- The Contractor will be required to submit a detailed water control plan to the USACE for approval. The plan will be submitted for review and comment to the MADEP, Boston and Brookline Conservation Commissions, and the MA Division of Marine Fisheries (MADMF).
- The plan will detail Contractor's actions to operate and maintain or remove the diversion system for each work area during normal and flood events. The plan will include complete construction drawings and detail drawings showing all aspects of the Muddy River control and diversion system for all work areas. For all pumps, details shall include manufacturer's information on pump performance curves, specifications, a control diagram, and written sequence of control for the pumping system.
- The submittal will include construction and detail drawings for all work areas enclosed by temporary cofferdam structure; width and shape of channel opening remaining to pass flows; number, sizes, and locations of pumps required to pass equivalent river capacity; number, sizes, and locations of pumps required to dewater within cofferdam; locations of outlets for pump dewatering discharge; and method of treatment of discharge water. Temporary cofferdam structures may include steel sheet piling, bladder dams, portadams (or equivalent) but will not include placement of fill.
- Detailed calculations shall be submitted for structural, geotechnical and hydraulic design aspects of the diversion system(s). Hydraulic calculations documenting calculation of the displaced flow and demonstrating that the proposed diversion system(s) will pass displaced flow without exceeding 6 inches of river level change upstream or downstream of diversions at all times including high water and floods. Pump selection justification including pump curves and head. Pipe calculations justifying selected pipe size and

thickness. Structural and geotechnical calculations documenting design of temporary cofferdam system including earth supports, pipe supports, pipe restraints, and equipment supports.

- Supplemental plans to restore any areas disturbed by water control activities which are not shown on 100% design landscape restoration drawings will also be submitted for review and approval. The supplemental drawings would be prepared by a historic restoration landscape architect approved by the USACE after consultation with project sponsors.
- To provide flood control benefits, the contractor will be required to remove the FRCS as soon as practical after completion of sediment removal from Work Areas 7 -12 and flood proofing of the Boston Fire Department facility. The entire structure, including sheet pile, stone protection, catwalk, and super sacks will be removed as discussed above.
- Any wastewater from dewatering or dredged material processing operations and other sources will not be discharged directly into surface waters, the storm drain system, sanitary sewers, or the Muddy River Conduit. Prior to discharge, water from dewatering operations will be treated by filtration, settling basins, or other approved methods to reduce the amount of sediment and contaminants contained in the water to allowable levels. Discharge standards for others parameter may be established by the MADEP during the permit process.
- Treated wastewater from dewatering, dredged material processing operations, or other activities that is discharged directly or indirectly into surface water will be tested daily for TSS and weekly for dissolved lead and dissolved oxygen. In work areas where sediment is excavated in the wet, surface water quality will be monitored daily at one station upstream of the work area and three downstream locations. Parameters measured will include dissolved oxygen, percent dissolved oxygen saturation, turbidity (NTU's), temperature, and conductivity.
- The contractor will prepare a plan for monitoring wastewater and surface water quality. The plan will include the following elements:
 - 1) List of parameters to monitor and detection limits
 - 2) Sampling method (s)
 - 3) Frequency of monitoring
 - 4) Monitoring locations (including a map)
 - 5) Reporting
 - 6) List of Personnel, Roles and Responsibilities
 - 7) Analytical Laboratory
 - 8) Equipment required
 - 9) Safety Plan
 - 10) Quality Assurance Project Plan (QAAP)

- Test results will be summarized in report(s) submitted to the Boston and Brookline Conservation Commissions and MADEP.

The USACE has developed a restoration plan for areas impacted by construction activities. The USACE worked closely with a landscape architect with extensive experience in historic landscape rehabilitation. The intent of the plan is to rehabilitate the landscape through a design that is compatible with the habit, form, scale and context of the historic vegetation and to restore wetland and riparian habitat. Historic conditions are known from surviving landscape plans and photographs. Plant species were selected based on a species list of historic plantings and plans from the Olmsted Archives (Frederick Law Olmsted National Historic Site) photographs, Boston Parks and Recreation Department records, site conditions, and availability of plant material from local or regional nurseries.

The Olmsted lists have been reviewed and native plants selected for significant majority of the project area. Species listed as invasive were avoided. Wetland seed mix and emergent species are entirely native, as are the ferns. In very limited cases non-native species with a track record of being noninvasive in this landscape were selected to support character defining features of the landscape. Of the 9,939 shrubs proposed 49 individuals are not native (forsythia) and of 119 trees, 19 individuals (London plane and willow) are not native but the species are already present in the landscape. Container grown plugs will be used to establish emergent vegetation and native wetland seed mix will be used in wet meadow areas. Substitutions consistent with historic landscape restoration goals may be required if planting success is not achieved during plant establishment period.

- The existing shoreline along the Riverway is severely eroded in many locations. This is likely due to fluctuating water levels, grazing by waterfowl, rill erosion caused by runoff, and steep slopes. The Phase 2 design includes placement of coir fiber rolls to hold the bank in most restored areas. The top of the rolls will be set at the normal water surface elevation, likely a few inches above EL 1.3 ft. In the Back Bay Fens coir rolls will also be used to retain fill placed to restore wetland vegetation. This will occur mostly downstream of the bridge adjacent to the Victory Gardens. The coir rolls will also be used to hold soil installed to create underwater shelves. The top of coir rolls will normally be set at EL 1.3 ft. in area without shelves and EL 0.3 where shelves are present. Above elevation 1.3 slopes greater than 3:1 (horizontal to vertical - h:v) will generally be stabilized with 100 percent biodegradable erosion control matting. Matting will not contain poly netting and strands of the matting will move independently to minimize the risk of wildlife entrapment.
- As previously mentioned, the Muddy River suffers from bank erosion. Multiple efforts have been under taken over the years to help restore and protect the river bank. This project provides an opportunity to improve the existing condition and provide restoration benefits. Banks will be restored to a less degraded state following this project and will result in reduced sediment loading, improved water quality (reduced suspended sediment) and improved ecological habitat (consistent with the goals of the WPA and the eligibility criteria for an Ecological Restoration Limited Project).
- Six inches of topsoil will generally be placed in area restored as area turf. No topsoil will be placed underwater except in areas to be planted with emergent plugs and emergent shelves

where topsoil will be installed as backfill to meet desired grades. Topsoil will be obtained from off-site. The specifications require that topsoil be tested for TOC, pH, grain size, and nutrients. Contaminant levels in topsoil must meet MassDEP Reportable Concentration (RCS) 1 criteria. Topsoil will conform to the limits presented in the project specifications. The topsoil may be adjusted to meet composition requirements by adding compost or inorganic components. Compost used will be derived from organic wastes including leaf and yard residues.

- Little information is available regarding historic planting of freshwater emergent plants in Olmsted's Emerald Necklace park system. There is no evidence that emergents were planted. Planting of emergents is included in the design because historic pictures do show an emergent fringe along the river and such a fringe occurs today in some areas along the Riverway. Also, there is a desire to restore emergent vegetation to the extent possible. The design includes seeding areas above the normal water surface elevation with a wetland seed mix or planting masses of wetland shrubs. Planting emergent plugs is generally limited to emergent "shelf" areas. These areas will be planted with a variety of emergent plants native to eastern Massachusetts. Most of the species selected have low stature, a requirement for historic restoration and aesthetics. Based on Phase I plantings and observations, several species (e.g. swamp loosestrife, blue flag, and sweet flag) chosen are expected to be somewhat resistant to grazing. The emergent plants will be protected by an herbivore exclusion fence for at least two years to allow the roots system/rhizome system to become resistant to grazing. Effort to restore emergent vegetation during Phase I at created wetland shelves are still underway. Failed plantings are thought to be caused by grazing by carp which were able to swim under the Phase 1 exclusion fencing. Phase 2 design emphasizes planting of sweet flag which appears relatively resistant to grazing in Phase 1. Pickerelweed and bur-reed will be limited to near shore/bank areas where carp grazing should be less intense. The plant diversity gained through *Phragmites* removal and wetland vegetation restoration from the Phase 2 project will greatly improve the ecological value for aquatic, avian and terrestrial biota.
- Wetland areas will be seeded or planted with shrubs between elevation (EL) 1.3 and 2.3 feet. All trees and other shrubs will be planted above EL 2.3 feet. Wetland shelves will be planted with plugs to a depth of about EL 0.8 feet. No upland species will be planted below EL 3.3 feet.
- There will be a two-year guarantee period for all plantings. In upland areas one-hundred percent survival of trees and shrubs will be required. Performance standards for wetland vegetation will be based on percent cover. Areas between EL 1.3 and 2.3 seeded with a wetland seed mix or planted with emergent and wetland shrubs will have > 75 percent cover by native wetland plants after two years.
- Temporary fencing will be installed to protect emergent plantings from grazing by ducks, geese, and fish (carp) during the plant establishment period. The fencing will be installed along the water-side edge of all emergent plantings. Fencing will be used on the water side of the shelf areas to exclude carp. Fencing will also be installed on the upland side of the emergent plantings to exclude waterfowl. The entire restored area will be fenced to

prevent public access during construction and for a variable of time during restoration based on site conditions and consultation with the sponsors. The fencing is required to limit vandalism and unintentional incidental damage by the public to plant material and side slopes. Use of 4-foot-high coated chain link fencing is anticipated (similar to Phase 1).

- Seed mixes for lawn areas contain a mix of typical turf species, primarily fescues and ryegrasses. Mixes tailored for sun and shade areas and dense shade were specified. A seed mix of native wildflowers and grasses was developed for areas planted with trees and shrubs. The mix contains non-invasive species which typically grow less than about three ft. tall and includes species used by pollinators and species with aesthetic appeal. The wetland seed mix will be New England Wetland Plants "Wetmix" or an approved equal.
- Many trees occur within or near the limit of work. All trees to remain will be protected with fencing or trunk protectors as directed by an arborist. The condition of certain trees near work limits will be evaluated during construction. If an arborist determines the tree can be saved the construction contractor will be directed to do so. After consultation with USACE and the sponsors, the contractor will be required to remove hazardous trees and branches noted during the construction and maintenance period.
- Habitat logs will be installed to enhance fisheries and wildlife habitat. Habitat logs will be installed in restored areas. About 1/3 will extend into the water to provide basking locations for turtles and perches for wading birds. Logs will be hardwoods salvaged from on site with a minimum butt diameter of 8" and length between 8 and 12 feet.
- Watering will be required during the plant establishment period. Water will likely be supplied from watering trucks or an irrigation system connected to the local city water system. Pumping irrigation water from the river will not be permitted.
- Considerable grazing on shrubs by rabbit and possibly meadow voles occurred during Phase 1 restoration. Protectors on individual shrub plantings or other measures to deter stem damage (i.e., girdling) by herbivores will be required.
- Planted trees and shrubs will be pruned by an arborist during the plant establishment period to remove dead branches and improve growth form. Standard industry pruning practices will be adhered to. Wound dressing will not be applied. Weeding will be conducted as required to prevent shading of shrub and fern plantings by tall weeds such as burdock, hawkweed, and mugwort.

4.0 Wetlands Impacts/Benefits – Summary Phase 1 and Phase 2

The Muddy River Flood Control Project – Phase 1 and Phase 2 were split into two separate construction phases due to the nature and type of construction being different for each phase. However, when considering the interest of the Wetlands Protection Act (WPA) the impacts and benefits from the combined phases is significant. Not only do the combined phases provide significant flood control benefits, they also serve to significantly improve the natural capacity of the wetlands resource areas within the Muddy River project area to protect and sustain the interests identified in the WPA consistent with the eligibility criteria for an Ecological Restoration Limited Project. Extensive local, state and federal wetlands permitting for Phase 1 was

completed prior to construction. Substantial completion for construction Phase 1 was achieved in 2016 and there are ongoing requirements for vegetation establishment and management of the temporary flood restriction control structure. The proponents are in the process of permitting the work in wetlands resource areas in Phase 2 as discussed above.

The daylighting of nearly 700 linear feet of the Muddy River in the upper reaches of the Back Bay Fens (from Phase 1 construction) serves to compensate for the alteration of resource areas elsewhere in the Back Bay Fens (as a result of Phase 2 construction) and yield a net increase in the area of Land Under Water (LUW), Inland Bank and Bordering Vegetated Wetland (BVW). The daylighting of the river in the two specified areas resulted in approximately 1 acre (43,560 square feet) of additional Land Under Water, 1,690 linear feet of Inland Bank, and approximately 6,760 square feet of BVW. Combined with the replication proposed in the daylighted areas, the project will result in the increase of 0.3 acres (12,415 square feet) of the BVW in the Back Bay Fens. This estimate is based on a 4-foot-wide planting shelf as shown in the Plans.

Table 2 summarizes wetlands impacts for both the Phase 1 and Phase 2 construction projects. The combined project elements will improve the capacity of resource areas along the Muddy River to protect the interests of the WPA and result in a net increase of resource areas along the Muddy River consistent with the goals of an Ecological Restoration Limited Project. As presented in Table 2, the project will result in re-classification of some wetland resource areas along with an increase in overall resource areas within the entire project corridor.

Table 19
Summary of Wetland Impacts for Each Phase

Wetland Resource Areas	Units	Phase 1 (Boston)	Phase 2 (Boston)	Phase 2 (Brookline)	Total (Phase 1 and 2)
Land Under Water					
<i>Created</i>	<i>sq. ft.</i>	69,706	-	-	69,706
<i>Restored</i>	<i>sq. ft.</i>	66,463	634,287	36,163	736,913
Bordering Vegetated Wetland (BVW)^{1,2,3}					
<i>Excavated or other alteration</i>	<i>sq. ft.</i>	7,400 ⁴	83,196	10,245	100,841
<i>Restored/ Created</i>	<i>sq. ft.</i>	15,000 ⁵	50,987	5,607	71,594
Bank					
<i>Created</i>	<i>l.f.</i>	1,938	-	-	1,938
<i>Restored</i>	<i>l.f.</i>	1,692	5,115	844	7,651

Riverfront					
Created	<i>sq. ft.</i>	48,450	-	-	48,450

1. All BVW is also classified as Federal emergent wetland.
2. Nearly all BVW and Federal emergent wetland lost is Phragmites.
3. BVW delineation provided by project sponsors.
4. From Phase 1 NOI, includes 4,850 sq. ft. Phragmites.
5. Estimated, based on post construction monitoring and adaptive management.

Since the Phase 1 project was initiated, the City of Boston, the Boston Water and Sewer Commission (BWSC), the Town of Brookline, and the Massachusetts Department of Conservation and Recreation (DCR) greatly improved their stormwater Best Management Practices (BMPs) to reduce sediment loading into the watershed. The Town of Brookline, which is responsible for 85% of the watershed, changed their snow and ice management practices to eliminate sand and the Town has also implemented revised stormwater standards for new projects including requirements for long-term maintenance of stormwater systems. Similarly, the City of Boston has improved snow and ice management practices to reduce sediment loading. In addition, DCR has added/repaired curbing along roadways within the Muddy River watershed to reduce sediment runoff. Both BWSC and the Town maintain regular catch basin cleaning programs, and they both along with DCR continue a heavy street sweeping program in the watershed. Information regarding the stormwater operations and maintenance activities will be provided to MassDEP under separate cover.

The Muddy River Flood Damage Reduction project will create or restore approximately 18 acres of land under water. Phase 2 restoration involves restoration of former open water habitat by removal of Phragmites, restoration of open water habitat by removal of mudflats or sediment islands and deepening of existing open water habitat. Although the flood control project does not propose bank to bank dredging as proposed for environmental restoration, a substantial proportion of the Back Bay Fens and Riverway will be dredged. The 2003 EA (USACE, 2013) mapped 11.1 acres of open water in the Back Bay Fens and 6.4 acres in the Riverway (see Figures 2-12 and 2-13). The acreage of open water habitat in the Back Bay Fens and Riverway following completion of Phase 2 will be approximately 15 and 7 acres, respectively.

The depth of dredging will be variable. Up to 7 feet of sediment will be excavated in Leveret Pond (Area 1), 6 feet in the Riverway, and 10 feet in the Back Bay Fens. Approximately 88,000 cubic yards (cy) of sediment will be removed. 14,000 cy of topsoil and rock fill will be installed underwater for wetland restoration or erosion control. The net increase in volume of land under water will be about 74,000 cy.

Shallow (0 – 12-inch deep) vegetated shelves created during Phase 1 and Phase 2 in the Back Bay Fens will provide nesting and nursery habitat for fish and foraging habitat for wading birds such as great blue heron. Eight shelves were constructed during Phase 1 and additional shelves will be constructed during Phase 2 as shown on the plans. Habitat logs installed in the Riverway and

Fens will provide basking sites for turtles and cover for fish. These have proven to be well used by turtles in the area.

Excavation in Work Area 10 will remove mudflat and a sand island downstream of the Stonybrook gatehouse drain. Mudflat and a sand island will also be removed from Area 1 (Leverett Pond). Phase 2 will remove shallow mud flat areas present under normal flow conditions in Work Areas 2 through 5.

In addition to restoring stream habitat and land under water, Phase 1 and Phase 2 will significantly improve aquatic connectivity. Phase 1 removed over 700 ft. of culverts which isolated the Riverway from the Back Bay Fens. Phase 2 activities will include removal of the FRCS, which is the only remaining significant anthropogenic barrier between the Back Bay Fens and Leveret Pond. Restoration of connectivity will benefit both resident warm water species and blue back herring, an anadromous species which spawns in Leverett Pond.

Sediment removal is expected to somewhat improve water quality in the Back Bay Fens. Sediment removal will improve DO levels in surface waters by 1) reducing sediment oxygen demand (SOD) by exposing well decomposed (weathered) underlying sediment with lower SOD than existing surface sediment, and 2) increasing the volume of water in the Back Bay Fens and reducing the effect of SOD on DO levels. Removal of nutrient rich surface sediment may also reduce plant productivity and oxygen demand exerted by decomposing plant material. Water quality modeling by the USACE (USACE, 2003, Table EA-26) estimated that flood control project would reduce the percent area with low DO (< 5 mg/l) in the Back Bay Fens from 100% without sediment removal to 50 - 70 % 25 years after construction. Modeling showed flood control dredging to have no measurable effect on DO in the Riverway where 100% of the area is modeled to experience DO levels < 5 mg/l under both with and without project conditions.

A mathematical model developed by Mathew et al. (2011) attributed poor water quality in the Muddy River primarily to significant internal inputs, attributed to waterfowl, sediment, and algal production. The study postulated that sediment removal planned as part of the full restoration project should lead to significant improvements in DO and biological oxygen demand. Although the full restoration project evaluated by Mathew et al. is not being implemented, sediment is being removed from a significant portion of the Back Bay Fens, so some improvement in DO is likely to occur in the Fens, as also predicted by the USACE model.

Water quality may also be improved by bank stabilization of impacted areas during Phase 2 and continued implementation of BMP's in the watershed to reduce loading of sediment, organic material, nutrients, and contaminants to surface waters from storm drains and non-point sources.

Testing by CDM (2001) and the USACE (2003) show that contaminant levels in underlying sediment are generally lower than concentrations in existing surface sediments. CDM (2001) measured levels of metals, PAHs, PCBs, pesticides, and other chemicals at 2 ft. intervals ranging from 0-2 feet to 10-12 feet USACE (2003) used this information was used to predict the concentration of selected chemicals in sediment exposed by dredging. The proposed dredging will generally expose sediment with lower levels of contaminants than in surface sediments in the Back Bay Fens. Lead, cadmium, chromium, mercury, PAH, PCBs and DDT concentrations will be lower in exposed sediment. In the Riverway, PAH levels will be greatly lower in exposed

sediment. PCB and some metal levels will also be lower, but DDT levels in exposed sediment may be higher than existing surface sediments at Riverway. Lower PCB concentrations in surface sediment will likely result in lower PCB levels in fish and aquatic invertebrates and less food chain exposure to wildlife.

Risk of PAH mixtures to benthic communities can be assessed using by using an equilibrium partitioning method developed by the USEPA (2000). An ESG greater than 1 is indicative of ecological risk. PAH mixture ESGs were above 1 at all locations in the Riverway and Back Bay Fens (USACE, 2003). Post construction PAH ESG levels will likely be less than 1 in restored areas.

Toxicity testing indicates sediments in the Riverway and Back Bay Fens are toxic to aquatic invertebrates (USACE, 2003). Lower levels of contaminants following excavation in Phase 2 work areas should reduce sediment toxicity but risk screening levels (MacDonald, 2002) for some contaminants will likely still be exceeded. Surface sediments in the daylighted sections in the Back Bay Fens and shallow (0-12 inch) shelves created during Phase 1 and Phase 2 in the Back Bay Fens are expected to have much lower contaminant levels than sediment elsewhere in the Muddy River. The shelves were created using clean topsoil.

Approximately 1.6 acres of emergent (mostly wet meadow) or wet meadow/scrub-shrub wetland will be restored during Phase 1 and 2. Most of the restored wetland will be in the Back Bay Fens, but a narrow wetland fringe will be restored in work areas along the Riverway. As described below, the restored wetland will have greater functional value than the existing Phragmites.

Plant community diversity is expected to be much higher in restored wetlands than in existing Muddy River Phragmites stands which are essentially monospecific. Monitoring of areas restored during Phase 1 indicates that the fridge wetland on the bank supports a diverse native wetland plant community (USACE 2017b, 2018). A similar diverse wetland community is expected to develop in wetlands restored during Phase 2 along the Riverway and Back Bay Fens. Species noted in the Phase 1 fridge wetland in September of 2017 and/or 2018 include elderberry, water willow, sweet gale, pickerelweed, sweet flag, bugleweed, umbrella sedge, cattail, beggar-ticks, false nettle, boneset, Joe pye weed, blue vervain, soft rush, jewelweed, Pennsylvania smartweed, soft rush, spike rush, and water purslane.

The plant species community diversity in restored wetlands is expected to vary with time, but a moderate to high diversity community is expected to persist. To date wetlands restored during Phase 1 have not been colonized by Phragmites or Japanese knotweed despite the presence of potential seed sources upstream along the Riverway.

Phase 2 will avoid impacting a 7,500 square foot cattail wetland located in the Back Bay Fens upstream of Agassiz Road. This wetland is the only sizable emergent wetland in the Riverway or Back Bay Fens not dominated by Phragmites.

The removal of Phragmites will be substantially mitigated by restoring wetland along the Back Bay Fens shoreline as shown on landscape plans included with project drawings. Restored wetlands will be seeded with a diverse wetland seed mix and planted with shrubs with high wildlife habitat value such as buttonbush, common elderberry, red osier dogwood, and summersweet. Wetland community diversity will be further enhanced by planting emergents

such as pickerelweed, bur reed, blue flag iris, and sweet flag along the wetland shelf shoreline. Volunteer cattail, jewelweed, smartweed, Bidens, and other species will also likely colonize the shoreline and/or shallow water shelves. Water willow and sweet gale are expected to drape over and into the water providing habitat for young fish and aquatic invertebrates.

Restored wetlands in the Riverway and Back Bay Fens will support a diverse pollinator community (bees, wasps, butterflies, and hummingbirds) not currently supported by Phragmites. Many of species that will be planted or are expected to colonize restored wetlands have high value for pollinators. These include but are not limited to water willow, boneset, jewelweed, beggar-ticks, Joe pye weed, bugleweed, blue vervain, and pickerelweed.

The restored wetland will be established on clean soils, so should have a healthier soil invertebrate community than in the existing Phragmites wetland where surface soils are contaminated with concentrations of metals and PAHs that exceed USEPA Eco-SSL's and other ecological risk-based screening values. Wildlife such as worm eating birds and small mammals which prey on soil invertebrates should benefit from the enhanced invertebrate community.

Nearly 2000 linear feet (l.f.) of bank was created by Phase 1 daylighting and 1,692 l.f. of bank was restored in Upper Fens Pond. An additional 5,959 l.f. of bank will be restored in the Leverett Pond, the Back Bay Fens and the Riverway during Phase 2.

Existing banks along the Riverway and Back Bay Fens are typically in very poor condition. The banks are eroding and often poorly vegetated. The restored banks will be stabilized with coir fiber rolls and plantings. Bank restoration will reduce erosion and sediment deposition in the Riverway and Back Bay Fens. Vegetation seeded or planted on the banks will be similar to the Phase 1 fringe wetland described above and provide better wildlife habitat value than existing banks. As for emergent wetlands, the non-federal sponsors will be required to implement an Operations and Maintenance Plan developed by USACE which will include control of Phragmites and other invasive plants which could colonize and degrade the restored banks.

All Riverfront disturbed by Phase 2 construction activities will be restored. Restored areas will be planted with shrubs and trees and/or seeded with a native wildflower or native wetland plant seed mix. Restored riparian communities are expected to have greater plant diversity and better wildlife habitat value than the preexisting riparian communities. As with emergent wetlands and bank, the non-federal sponsors will be required to implement an Operations and Maintenance Plan developed by USACE which will include control of Japanese knotweed, Phragmites and other invasive plants which could colonize and degrade the restored riparian habitat.

Phase 1 created 1.1 acres of new riverfront in the Back Bay Fens and restored riparian habitat along the Upper Fens Pond. Monitoring of areas restored during Phase 1 indicates that the created and restored riparian habitat supports a diverse plant community (USACE, 2017, 2018). The community is free from invasive species and has been planted or seeded with many species with good wildlife habitat value, including shrubs and herbs used by pollinators. Riparian habitat restored during Phase 2 should have similar beneficial attributes.

The Phase 2 restored riparian habitat will be established on clean surface soils, which should have lower contaminant levels than are typical of urban soils. This should benefit the soil invertebrate community and wildlife which prey on soil invertebrates.

5.0 Invasives Management

5.1 Introduction

Extensive stands of *Phragmites* are present in the Riverway and Back Bay Fens. Although some varieties of *Phragmites* are native to the northeastern United States, studies indicate that all native New England varieties have been supplanted by a highly invasive Eurasian variety (Saltonstall, 2002). *Phragmites* varieties occurring in the Muddy River were studied by Keller (2000).

Phragmites currently occurs along about 20 percent of the Riverway shoreline. Additional *Phragmites* is present along embankments up to several ft. above the above the normal water elevation. *Phragmites* growth in the Riverway is robust. In well-established stands, shoots frequently exceed 3 meters in height, and range up to nearly 7 m. *Phragmites* aboveground live standing crop near Park Drive in October, 1992 was about 4,000 g/m² (dry weight), well above values typically reported for *Phragmites* in North America.

Phragmites has constricted the river channel in numerous locations. Growth is most extensive from the Footbridge downstream to Park Drive, near Riverwalk Island, and downstream of Route 9. Stands extend along both banks of the river for about 400 ft upstream of the Park Drive culverts. In some locations, the inner edge of this stand appears to be semi-floating in about 4 ft. of water. Some stands previous mapped by CDM (2001) and the USACE (2003) have disappeared, most notably upstream of the Footbridge. Several thousand square ft of *Phragmites* was excavated during installation of the Riverway culvert and the FRCS during Phase 1.

Conditions are favorable for continued expansion of *Phragmites* throughout much of the Riverway. Mudflat and shallow water habitat, lack of heavy shading, nutrient rich sediments, slow current provide good conditions for *Phragmites* growth.

Phragmites occupies about 6 acres in the Back Bay Fens. As along other areas of the Muddy River, *Phragmites* stands in the Fens are extremely robust (maximum shoot height is 6-7 meters). The stands have eliminated scenic vistas envisioned by Olmsted and strongly detract from the aesthetics of the area. *Phragmites* also poses a threat to the environment and to public safety as a result of illicit activity and illegal dumping. Google Earth imagery from April 2018 shows an extensive network of trails and several homeless encampments within the *Phragmites*. The encampments were recently addressed in conjunction with two Emergency Orders issued by the Boston Conservation Commission. The *Phragmites* stands are also prone to occasional fires, several of which have been quite severe.

Not only does removal of accumulated sediment and *Phragmites* improve water conveyance preventing flooding, it provides significant ecological restoration benefits. Benthic substrate quality is improved for invertebrate colonization which become a food source for fish, including anadromous fish. Improving water flow minimizes stagnation that can lead to depressed oxygen, increase temperatures and nutrient concentrations and algal blooms.

5.2 Construction Phase – Invasives Management

In areas impacted by Phase 2 construction, invasives will be addressed through the dredging and removal activities discussed above. However, restored habitat will be vulnerable to colonization by invasive species present in adjacent areas. Reused or imported topsoil may also contain viable seeds of invasive species. Primary invasive species of concern include Norway maple, Tree of Heaven, European buckthorn, Oriental bittersweet, Japanese knotweed, *Phragmites*, and purple loosestrife. Colonization of other plant species classified as “invasive” by the Massachusetts Invasive Plant Advisory Group may also occur.

All invasive plant species will be controlled in restored areas during the 2-year establishment and monitoring period. Over the long term an Operation and Maintenance Manual will discuss invasive species management. Because *Phragmites* can readily spread by seed and will remain in the Riverway and Back Bay Fens proximal to the project area, annual monitoring and control efforts are required. USACE recommends zero tolerance for *Phragmites* in all restored areas to ensure the ecological and flood conveyance benefits are maintained.

An invasive plant species control plan will be developed by the contractor and approved by the USACE in accordance with the Specifications. The plan will rely on frequent meander surveys through restored areas to detect invasive species and the controlled use of herbicide when hand pulling would not be an effective control method. All herbicide use will be in accordance with label instructions, state and federal law, and the Order of Conditions received from the Boston

and Brookline Conservation Commissions. Herbicides will be applied by Massachusetts certified herbicide applicators.

Figure 2 Phragmites



5.3 Invasives Management— ~~Pilot Program~~After Construction

~~The City of Boston will continue to maintain the Phase 1 and Phase 2 areas following construction completion and final acceptance. The City prepared the "Muddy River Restoration Project Maintenance and Management Plan", included in Appendix H, as part of the MEPA Process. The methodology used to develop the Maintenance and Management Plan follows the benchmarking standards developed by the National Recreation and Park Association, the Professional Grounds Management Society, and the Secretary of the Interior's Standards for the Treatment of Historic Properties, which define the preservation approaches for historic properties and provide general guidance for acceptable treatment work. The methodology for specific maintenance analysis or management approaches is more fully described in the Plan.~~

With conditions favorable for continued expansion of Phragmites into the completed work areas throughout much of the Riverway and Back Bay Fens areas it is critical to develop a landscape rehabilitation invasives management plan to address areas of the work outside the limits of the USACE Phase 1 and Phase 2 projects. Much of the area outside the limits of the USACE project still have large stands of phragmites that are not being addressed as part of the Phase 1 and Phase 2 construction. In addition to the large stands (which will serve as a continuous seed source) the areas not impacted by construction include mudflat and shallow water habitat, lack of heavy shading, nutrient rich sediments and slow current which provide good conditions for Phragmites growth.

In addition to the Phase 2 work proposed by the USACE, the City of Boston has also submitted a Notice of Intent to the Boston Conservation Commission to allow for a pilot project involving low impact invasives management. This low impact project will include mowing of phragmites and over-seeding with a wetlands seed mix. The proposed limit of work is with the Riverway and Back Bay Fens areas of the Muddy River. This work is also being proposed as an Ecological Restoration Limited Project consistent with the eligibility criteria and the interests of the WPA.

The proposed work under this Notice of Intent will include:

- ~~Landscape Rehabilitation outside of the USACE Phase 2 work area;~~
- ~~Low impact mowing of phragmites and seeding of bordering vegetated wetland and bank with New England wetland seed mix;~~
- ~~Landscape Rehabilitation in the USACE Phase 2 area (in advance of construction);~~
- ~~Low impact mowing of phragmites and seeding of bordering vegetated wetland and bank with New England wetland seed mix;~~
- ~~Long Term management of phragmites and vegetation monitoring in the Riverway and Back Bay Fens areas of the Muddy River.~~

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6.0 Eligibility Criteria for Inland Ecological Restoration Limited Project

6.1 General Eligibility

The Project is an Ecological Restoration Project as defined in 310 CMR 10.04, eligible as a Flood Control and Invasive Species Management Project. The Project will further the following WPA interests:

- Flood Control – The Phase 2 Project will excavate and deepen portions of the Muddy River to allow for increased flow and achieve and maintain flood damage protection.
- Storm damage prevention – By excavating and deepening the Muddy River, increased flow will be allowed to pass through the river, preventing future flooding and storm damage.

6.2 Estimated Habitat Map of State-Listed Rare Wetlands

The Project is not located within estimated habitat areas per Natural Heritage Endangered Species Program (NHESP) 2018 mapping.

6.3 Time of Year Restrictions Recommended by the Division of Marine Fisheries (DMF)

The Commonwealth of Massachusetts DMF has recommended that the Muddy River remain free flowing during Phase 2 construction between April 1st to June 15th and between September 15th and November 1st, of any year. The Project will comply with the recommendations from DMF.

6.4 Water Quality Certification

The Project involves dredging over 100 cubic yards, therefore, the USACE has submitted a Water Quality Certification Application, ~~included in Appendix B.~~

6.5 Ecological Benefits

In addition to furthering the WPA interests of flood control and storm damage prevention, the Project will provide significant ecological benefits, as described in Section 4 of this Narrative.

6.5.1 Streamflow

The Phase 2 project will eradicate phragmites in the Back Bay Fens and Riverway areas where necessary to achieve and maintain flood damage reduction. In some places, phragmites are completely or nearly completely blocking the channel. The implementation of the Project will alleviate these flow restrictions and improve efforts to restore anadromous fish runs.

6.5.2 Water Quality

Additionally, organic loading from emergent vegetation (phragmites) is currently contributing to the degraded water quality of the Muddy River. The Phase 2 project will restore former open water habitat by removing phragmites, mudflats, sand islands, and deepening existing open water habitat. The water quality benefits are described in detail in Section 4 of this Narrative.

6.5.3 Riparian and Emergent Wetland Vegetation

Much of the intended diversity in the Muddy River has been lost over the years due to the introduction of non-native exotics such as Oriental knotweed, purple loosestrife, Phragmites, Norway maple, and glossy buckthorn. The removal of vegetation such as phragmites will improve the habitat value of the resource area. The wetland vegetation will be restored in dredged areas by seeding and planting where appropriate. The plant community diversity is expected to be much higher in restored wetlands. The USACE prepared the following evaluation for the 401 Water Quality Certification permit application. It is important to note that the removal of the phragmites will be a temporary impact as the invasive, exotic, monoculture of giant reed is replaced with a diverse, native wetland mix.

The restored wetland will have greater functional and ecological value than the existing phragmites marsh. The plant community diversity is expected to be much higher in restored wetlands than in existing Muddy River phragmites stands which are essentially monospecific. Monitoring of areas restored during Phase 1 indicates that the fringe wetland on the bank supports a diverse native wetland plant community (USACE 2017b, 2018). A similar diverse wetland community is expected to develop in wetlands restored during Phase 2 along the Riverway and Back Bay Fens. Species noted in the Phase 1 fringe wetland in September of 2017 and/or 2018 include elderberry, water willow, sweet gale, pickerelweed, sweet flag, bugleweed, umbrella sedge, cattail, beggar-ticks, false nettle, boneset, Joe pye weed, blue vervain, soft rush, jewelweed, Pennsylvania smartweed, soft rush, spike rush, and water purslane.

The plant species community diversity in restored wetlands is expected to vary with time, but a moderate to high diversity community is expected to persist. The non-Federal sponsors will be required to implement an Operations and Maintenance Plan developed by USACE which will include control of Phragmites and other invasive plants which could colonize and degrade the restored wetlands. To date, wetlands restored during Phase 1 have not been colonized by Phragmites or Japanese knotweed despite the presence of potential seed sources upstream along the Riverway.

Phase 2 will avoid impacting a 7500 sf cattail wetland located in the Back Bay Fens upstream of Agassiz Road. This wetland is the only sizable emergent wetland in the Riverway or Back Bay Fens not dominated by Phragmites.

In the Back Bay Fens, loss of Phragmites habitat will have an adverse effect on songbirds and other wildlife that use the wetlands for cover in an otherwise highly urbanized area. About 1.7 acres of Phragmites will remain the Back Bay Fens after Phase 2 construction, mostly along the right bank of the river adjacent to the Boston Fire Department (Fire Alarm Control Center). This stand will continue to provide nesting and foraging habitat, and valuable cover, especially in winter, for songbirds and other wildlife. The cattail stand located upstream of Agassiz Road will remain and will also provide nesting and cover habitat.

The loss of Phragmites will be substantially mitigated by restoring wetland along the Back Bay Fens shoreline as shown on landscape plans included with project drawings. Restored wetlands will be seeded with a diverse wetland seed mix and planted with shrubs with high wildlife habitat value such as buttonbush, common elderberry, red osier dogwood, and

summersweet. Wetland community diversity will be further enhanced by planting emergents such as pickerelweed, bur reed, blue flag iris, and sweet flag along the wetland shelf shoreline. Volunteer cattail, jewelweed, smartweed, Bidens, and other species will also likely colonize the shoreline and/or shallow water shelves. Water willow and sweet gale are expected to drape over and into the water providing habitat for young fish and aquatic invertebrates. As discussed above, with proper management, the restored wetland community is expected to persist long-term.

Restored wetlands in the Riverway and Back Bay Fens will support a diverse pollinator community (bees, wasps, butterflies, and hummingbirds) not currently supported by Phragmites. Many of species that will be planted or are expected to colonize in the restored wetlands have high value for pollinators. These include but are not limited to water willow, boneset, jewelweed, beggarticks, Joe pye weed, bugleweed, blue vervain, and pickerelweed.

The restored wetland will be established on clean soils, so should have a healthier soil invertebrate community than in the existing Phragmites wetland where surface soils are contaminated with concentrations of metals and PAHs that exceed USEPA Eco-SSL's and other ecological risk-based screening values. Wildlife such as worm eating birds and small mammals which prey on soil invertebrates should benefit from the enhanced invertebrate community.

6.5.4 Wildlife

Numerous birds, mammals, amphibians, and reptiles are known to occur in the Project area. Ecological restoration will provide improved conditions for bird species, ducks, Canada goose, turtles, and fish.

6.6 Additional Eligibility Criteria for Specific Inland Ecological Restoration Limited Project Types

This project meets the eligibility criteria for Ecological Restoration Limited Project in accordance with 310 CMR 10.53 to ensure that the restoration and improvement of the natural capacity of a Resource Area and furthers the WPA interest for Other Ecological Restoration Projects, including:

- Fill removal and re-grading
- Invasive species management

7.0 Required Actions

7.1 Massachusetts Environmental Policy Act (MEPA)/Environmental Monitor

The City of Boston submitted written notification for the Notice of Intent for Ecological Restoration of a Limited Project to the MEPA Environmental Monitor and was published on October 10, 2018. A copy of the written notification is included in Appendix D.

The City of Boston and the Town of Brookline previously submitted a Supplemental Final Environmental Impact Report in February of 2005 to MEPA for the Muddy River Flood Control, Water Quality and Habitat Enhancement and Historic Preservation Project in February of 2005

and received a Certificate on April 1, 2005. A Notice of Project Change is being submitted to MEPA in November 2018 for the Phase 2 Project.

7.2 Massachusetts Endangered Species Act (MESA)/Wetlands Protection Act Review

The Phase 2 Project Area is not mapped as priority habitat of rare species or estimated habitat of rare wetlands wildlife (MA NHESP, 2018). No Federally-listed threatened or endangered species occur in the Phase 2 Project Area.

7.3 Estimated Habitat Map of State-Listed Rare Wetlands Wildlife

The Phase 2 Project Area is not mapped as an Estimated Habitat of Rare Wildlife as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by Natural Heritage and Endangered Species Program (NHESP, 2018).

7.4 Division of Marine Fisheries

The proposed Phase 2 project does not occur within a coastal waterbody.

7.5 Division of Fisheries and Wildlife

The Commonwealth of Massachusetts Division of Marine Fisheries has recommended to USACE that the Muddy River remain free flowing during Phase 2 construction between April 1st to June 15th and between September 15th and November 1st, of any year. This restriction was recommended so that blueback herring can complete their spring upstream adult spawning migration and fall downstream out-migration of juveniles.

7.6 MassDEP Water Quality Certification

The USACE has submitted a Water Quality Certification Application to MassDEP for the Phase 2 Project. ~~A copy of the application is included in Appendix B.~~ When USACE receives a Water Quality Certificate, a copy will be provided to the Boston Conservation Commission.

7.7 MassDEP Wetlands Restriction Order

The Phase 2 Project area is not subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act.

7.8 Department of Conservation and Recreation

7.8.1 Office of Dam Safety

The Phase 2 project does not include work on a dam.

7.8.2 Areas of Critical Environmental Concern (ACECs)

The Phase 2 Project area is not in an ACEC.

Appendix G

Phase 2 Specifications by USACE



**US Army Corps
of Engineers®**
New England District

W912WJ19Rxxxx

Muddy River Flood Damage Reduction Project (Phase 2)

Boston and Brookline, Massachusetts

Construction Solicitation and Specifications

100% Permit Copy

August 2018

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GEOTECHNICAL DATA

PART 1 GENERAL

1.1 SUMMARY

The surface conditions indicated on the contract drawings and in the specifications are the result of site surveys, borings and test pits, and laboratory tests. Copies of the logs of explorations, laboratory test (geotechnical and environmental) results, and locations at the site where subsurface investigations were performed are attached at the end of the specifications as an appendix. Groundwater data and data collected from existing observation wells is also attached at the end of the specifications in the appendix.

1.2 GENERAL DESCRIPTION OF MATERIAL TO BE EXCAVATED

Under this contract Muddy River sediment will be excavated and transported from the site. The sediment is a saturated black organic silt that is potentially contaminated and mixed with natural and man-made debris which has fallen or been tossed into the river.

The natural debris includes downed trees and limbs, stones, and layers of leaf litter mixed with brush including Phragmites shoots, roots, and rhizomes. Man-made debris includes construction debris, shopping carts, tires, metal machine parts and other scrap metal, safe doors, automobile parts, bottles and cans, general household debris, discarded hypodermic needles and syringes, plastic items of all kinds, and general trash.

The material to be excavated has little to no strength or bearing capacity and flows laterally when excavated. The thickness of the organic material varies. Probe depths in the material varied from two to nine feet and some encountered refusal. Excavations for this project are generally within the Muddy River Channel, but will be deeper between the pedestrian bridges and the Charles River and may encounter the underlying soil.

The Contractor for the Phase 1 effort isolated the Upper Fens Pond with sheet piles then dewatered while by-pass pumping the river's flow. This Contractor mixed the material with dry sawdust, excavated the more stable material, stockpiled to allow further drying, and then loaded it onto trucks for off-site disposal. This sequence of work is provided for information only.

Subsurface testing was primarily for sediment characterization. The data is collected in the attached "Compilation of Sediment Quality Information" and "Dewatering Summary Report". The samples were from several investigations including 139 locations sampled by Geotek from July 2000 through October 2000; Sedimentary Boring Logs are attached from Camp Dresser and McKee; Vibra-core logs by AEC from 2014 are presented in Table 2. Section 2.1.4 gives thickness of mud samples down to gravel (Atterberg Limits, Grain size, and Specific gravity are presented in Tables on pages 23-31 and 58-63); Water elevation/depths are provided in Attachment B and Core logs are in Attachment C.: Attachment E has the Geo-testing Express results on pages 1615-1674 and 1675-1732.

Groundwater and observation well data is available on the Boston Groundwater Trust website (<http://bostongroundwater.org>). The data for wells downstream of the Muddy River Phase 1 includes an up to date history of readings including abandoned wells.

If the Phase 2 work will be built in the river without dewatering the river, no cofferdams are required. However, working in the dry will require separation of river sections and dewatering to meet the requirements of the contract drawings and specifications. No soil test boring have been conducted for coffer dams (sheeting) within the Muddy River Phase 2 sections. A minimum of one boring shall be drilled within 10 feet of the centerline of the cofferdam for each 100 feet of length (width of river) is required. The depth of borings shall extend to 5 feet below the design depth of sheeting.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2435	(2011) Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	(2009a) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2974	(2007a) Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
ASTM D422	(1963; R 2007) Standard Test Method for Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4767	(2011) Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

1.4 EXAMINATION OF SAMPLES

Subsurface explorations were performed by the U.S. Army Corps of Engineers. Pertinent subsurface information is attached to this section of the specifications. Materials obtained from the subsurface explorations are available for examination. Arrangements to view the samples shall be made with Mr. George Claflin of the U.S. Army Corps of Engineers, New England District (USACE), Geotechnical Engineering Section, telephone number 978-318-8081. Two working days prior notice is required in order

that samples can be removed from storage and set up for examination.

1.5 SUBSURFACE REPORTS

Subsurface information relative to the construction of Phase 2 of the Muddy River Project are attached at the end of the specification document.

1.6 SOIL CLASSIFICATION

The soil classification of the USACE soil samples was performed in accordance with [ASTM D2488](#) in the field and [ASTM D2487](#) in the laboratory.

1.7 INTERPRETATION

Subsurface investigation data and material descriptions in this section are provided only for information purposes and for the convenience of the Contractor. The data shown on the boring logs is for the specific locations indicated only and no assurance is given that these conditions are representative of conditions between borings or areas adjacent thereto. The responsibility lies with the Contractor to interpret subsurface conditions and material characteristics that may affect his work.

1.8 LABORATORY TESTS

Laboratory tests were generally performed in accordance with the following test methods:

- a. Moisture Content: [ASTM D2216](#).
- b. Organic Content: [ASTM D2974](#).
- c. Particle-Size Analysis: [ASTM D422](#).
- d. Liquid Limit, Plastic Limit, and Plasticity Index: [ASTM D4318](#).
- e. Consolidation: [ASTM D2435](#).
- f. Triaxial Testing: [ASTM D4767](#)

Note: Not all samples were tested in the laboratory using all the methods described above.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

BIDDING SCHEDULE

Refer to Section 01 22 00 MEASUREMENT AND PAYMENT

Item No.	Description	Quantity	Unit	Unit Price	Amount
0001	Flood Reduction Excavation in Work Area 1	1	Job	Job	\$_____
0002	Landscaping in Work Area 1	1	Job	Job	\$_____
0003	Flood Reduction Excavation in Work Area 2	1	Job	Job	\$_____
0004	Landscaping in Work Area 2	1	Job	Job	\$_____
0005	Flood Reduction Excavation in Work Area 3	1	Job	Job	\$_____
0006	Landscaping in Work Area 3	1	Job	Job	\$_____
0007	Flood Reduction Excavation in Work Area 4	1	Job	Job	\$_____
0008	Landscaping in Work Area 4	1	Job	Job	\$_____
0009	Flood Reduction Excavation in Work Area 5	1	Job	Job	\$_____
0010	Landscaping in Work Area 5	1	Job	Job	\$_____
0011	Flood Reduction Excavation in Work Area 6	1	Job	Job	\$_____
0012	Landscaping in Work Area 6	1	Job	Job	\$_____
0013	Flood Reduction Excavation in Work Area 7	1	Job	Job	\$_____
0014	Landscaping in Work Area 7	1	Job	Job	\$_____
0015	Flood Reduction Excavation in Work Area 8	1	Job	Job	\$_____
0016	Landscaping in Work Area 8	1	Job	Job	\$_____
0017	Flood Reduction Excavation in Work Area 9	1	Job	Job	\$_____
0018	Landscaping in Work Area 9	1	Job	Job	\$_____
0019	Flood Reduction Excavation in Work Area 10	1	Job	Job	\$_____
0020	Landscaping in Work Area 10	1	Job	Job	\$_____

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0021	Flood Reduction Excavation in Work Area 11	1	Job	Job	\$_____
0022	Landscaping in Work Area 11	1	Job	Job	\$_____
0023	Flood Reduction Excavation in Work Area 12	1	Job	Job	\$_____
0024	Landscaping in Work Area 12	1	Job	Job	\$_____
0025	Flood Damage Reduction Measures at Fire Station	1	Job	Job	\$_____
TOTAL AMOUNT					\$=====

Note 1: Bidders must bid all items. The work will be awarded as a whole to one bidder. Offers will be evaluated and the low bidder determined by the Total Amount for Line Items 0001 through 0025.

Note 2: All work shall be completed within the time period specified in Section 00 80 00 SPECIAL CONTRACT REQUIREMENTS, Subpart COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984) FAR 52.211-10.

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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 PROJECT BACKGROUND

The Muddy River is a 3.5 mile long urban waterway with a 5.6 square mile drainage area situated in the greater Boston metropolitan area. The River originates at Jamaica Pond and flows in a generally northeasterly direction along the Boston-Brookline border, then turns into the Fenway neighborhood, and eventually flows into the Charles River. The upper watershed is primarily residential with some commercial areas, while the lower watershed is characterized by high-density residential, institutional, and commercial development. The river also comprises part of Frederick Law Olmsted's "Emerald Necklace" park system. Due to the historic significance of the park system, the river is listed in the National Register of Historic Places.

Flooding, degraded riverine habitat, poor water quality, and other related water problems have resulted in several prior studies of the river. In 1989 the Commonwealth of Massachusetts completed the Emerald Necklace Parks Master Plan which identified the need for environmental restoration and correction of potential flooding problems. However, it was a severe storm in October of 1996 that resulted in flooding causing over \$60 million in damages that forced the local stakeholders to take the situation more seriously.

The Boston Parks and Recreation Department, along with the Town of Brookline and Commonwealth of Massachusetts, commissioned a comprehensive basin wide plan entitled "The Emerald Necklace Environmental Improvements Master Plan, Phase 1 Muddy River Flood Control, Water Quality and Habitat Enhancement". This plan identified actions to reduce potential flood damages, improve water quality and habitat in the river, rehabilitate the historic landscape, and enhance recreational uses of adjacent parklands. Specific elements of the Master Plan included dredging the Muddy River system from Wards Pond to the Charles River basin, increasing the channel capacity and removing flow restrictions, stabilizing riverbanks, removing invasive vegetation, and rehabilitating the historic landscape.

Congress authorized the U.S. Army Corps of Engineers to evaluate the City of Boston's Master Plan and to determine whether these flood damage reduction and environmental restoration improvements were in the Federal interest. This required the preparation of a Decision Document. The September 2003 Final Decision Document evaluated alternative solutions to flood control and ecosystem problems. It selected and recommended a plan based on economic, environmental and public acceptability criteria. It also demonstrated a Federal and non-Federal interest in proceeding to the project implementation phase.

Phase 1 of the work involved construction of 10' by 24' concrete culverts under both the Riverway and Brookline Avenue, removing existing twin 72" pipes in the Old Sears Parking Lot and daylighting the river in this area, remove existing twin 72" pipes in the Brookline Avenue jug handle area and in the area just upstream of Avenue Louis Pasteur culvert, daylighting the

river in these two areas, reconstructing a culvert opening at the upstream end of the Avenue Louis Pasteur culvert, and dredging and reshaping the Upper Fens Pond section of the river to allow for increased flow.

Phase 2 of the work is covered by the specifications and drawings of this solicitation.

1.2 PHASE 2 WORK COVERED BY CONTRACT DOCUMENTS

The general description below is given to indicate the approximate scope of the Phase 2 project only. It does not limit the work required under the project drawings and specifications.

The work of this project consists of the following:

Excavate the river in the Backbay Fens area. Excavate five stretches of the Riverway section of the river. Excavations may be performed mechanically in wet conditions or by the establishment of water diversion structures with excavation performed in dry conditions. Handling, characterization and disposal of excavated material is required.

Excavate the sandbar and island at Leverett Pond. Handling, characterization and disposal of excavated material is required.

Provide additional flood protection at the Boston Fire Department Fire Control Center in the Backbay Fens.

Eradicate phragmites in the Backbay Fens and Riverway areas where indicated to achieve flood damage reduction.

Restore wetland vegetation in excavated areas by planting appropriate emergent wetland plants.

Restore riparian vegetation in upland areas where phragmites are eradicated by planting trees and shrubs.

Restore vegetation and other landscape features disturbed at staging areas and within the limit of work.

Installation of boulders and habitat logs for fish, turtles and amphibians.

Significant incidental work necessary to accomplish the work described above includes: control of river flow; control of ground and surface waters; pedestrian and vehicular traffic control; pedestrian management; protection of historic structures and landscape features to remain; invasive species control and selective clearing of vegetation; and maintenance of all restored areas within the limit of work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Construction Photographic Survey; G, RO

The Contractor shall submit a pre-construction survey as described in this section.

Hauling Plan; G, RO

SD-07 Certificates

Request Application; G, RO

Request Application to work outside the hours of operation.

1.4 SUPERINTENDENCE BY THE CONTRACTOR

a. At all times during the performance of the contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent project superintendent who is satisfactory to the Contracting Officer and has the authority to act for the Contractor.

b. The project superintendent shall maintain a physical presence at the site at all times and be responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

c. Failure to comply with these requirements shall be deemed as cause for a non-compensatory stoppage and suspension of work until the deficiency is remedied.

1.5 COORDINATION AND DIRECTION DURING CONSTRUCTION

a. The Contractor shall not take or accept any direction or instructions issued by any person, employed by the Government or otherwise, other than the Contracting Officer that changes the terms and conditions of contract actions, the scope, or any change that impacts the cost, price, or schedule. Changes authorized by the Contracting Officer will be in the form of a written, official, signed modification to the contract action received by the Contractor before the Contractor will act upon those changes. The Contractor will comply with the changes clause of this contract when the Contractor believes direction has been given from persons other than the Government Contracting Officer that equate to a change by notifying the Contracting Officer as directed by the clause. Any direction given by any Government employee or any other person outside their authority must be reported to the Contracting Officer.

b. The Contracting Officer Representative (COR) is limited to the authorities stated in the COR appointment letter. If a COR is appointed under this contract, they will be appointed by written letter from the Contracting Officer to the Contractor and COR specific to this contract only. COR appointment letters from previous contracts are not valid for this contract. See the Contracting Officer's Representative clause of this contract.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Other Construction Projects in the Area

The Contractor shall note that during the prosecution period of this project, other construction projects being completed by other Contractor's will be ongoing in the vicinity. These projects include the following:

1. Rehabilitation of the Carlton Street Footbridge (MassDOT 606316)
2. Fenway-Yawkey Multi-Use Path along the Riverside Line (MassDOT 607888)
3. Gateway East Project (MassDOT 605110)

The Contractor shall coordinate the work of this project to minimize interference with these other projects. The Contractor is responsible to employ appropriate precautions and actions to minimize interference.

1.6.2 Site Security

The Contractor shall report any vandalism, suspicious activities or devices to the Contracting Officer and local police as soon as possible. The Contractor shall note that work areas are located in areas where crime rates and vandalism are problematic.

1.7 WORK SEQUENCE AND SCHEDULING

1.7.1 Hours of Operations

Normal work hours are from 7:00 a.m. (Boston) and 8:00 a.m. (Brookline) through 6:00 p.m., Monday through Friday. The Contractor will not be permitted to work outside of normal work hours or on Saturday, Sunday or legal holidays unless otherwise authorized by the Contracting Officer and the City of Boston and/or Town of Brookline. The exclusion of work on Saturday, Sunday and legal holidays has been considered in computing the performance time of this contract. The following legal holidays are observed:

January 1st
Third Monday in January
Third Monday in February
Third Monday in April, Patriot's Day
Last Monday of May
July 4th
1st Monday of September
2nd Monday of October
11th of November
Fourth Thursday of November
25th of December

When one of the above designated legal holidays falls on a Sunday, the following Monday will be observed as a legal holiday. When a legal holiday falls on a Saturday, the preceding Friday is observed as a holiday.

Work outside the normal hours of operation requires Contracting Officer approval, and a waiver from the City of Boston and approval from the Town of Brookline Board of Selectman. The request to work outside the hours of operation shall be made in writing to the Contracting Officer 10 calendar days prior to such work to allow arrangements to be made by the Government. The [request application](#) shall include specific dates, hours,

location, type of work to be performed, contract number and project title, and names of all individuals who will be working outside the hours of operations. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.7.2 Work Sequence

1.7.2.1 General

There are certain essential criteria relative to the preparation of a work sequence and time schedule which the Contractor will be required to implement and follow during the prosecution of the work. Minor variations in the sequence of the items of work as specified may be made by the Contractor, provided such variations do not conflict with critical elements of the schedule. Proposed minor variations shall be noted on the progress charts submittal required by CONTRACT CLAUSE, entitled SCHEDULES FOR CONSTRUCTION CONTRACTS. Variations shall be approved by the Contracting Officer prior to implementation. See Subpart "Required Sequence of Construction" for construction sequence requirements.

1.7.2.2 Progress Schedule

See Section 01 32 01 PROJECT SCHEDULE.

1.7.2.3 Work Specified Elsewhere

Certain other construction sequence and time period restrictions relative to particular items of work are specified in the applicable specification sections to which the work pertains, and as specified on the contract drawings.

1.7.2.4 Required Sequence of Construction

There is no required sequence of construction for this project except as required to ensure that blueback herring (*Alosa aestivalis*) can complete their spring upstream adult spawning migration and fall downstream out-migration of juveniles, as specified in Section 01 57 20 ENVIRONMENTAL PROTECTION.

1.7.3 Organization at the Site

1.7.3.1 General

The Contractor shall employ ample personnel and sufficient equipment to accomplish the work of this contract in the least amount of time, within the prosecution period specified in SPECIAL CONTRACT REQUIREMENTS, Clause COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984) FAR 52.211-10.

1.7.3.2 Rate of Progress

Should the Contractor fail to maintain a satisfactory rate of progress in accordance with the Contractor's approved progress schedule, the Contracting Officer may require that additional personnel and equipment be placed on the work and weekend and overtime work be performed, in order that the work be brought up to schedule and maintained.

1.8 CONTRACTOR'S USE OF FACILITIES AND HAULING ROUTES

The Contractor shall be responsible for the following:

(1) Determining the trucking and hauling routes and associated restrictions to and from the work, to include the coordination for the use of such routes with local, State, and Federal authorities. Acceptable haul routes are shown on the contract drawings.

(2) Complying with all local, State, and Federal regulations and restrictions when using any facilities or hauling routes.

(3) The Contractor shall prepare and submit a [Hauling Plan](#) to the Contracting Officer for approval. The Contractor shall coordinate with the Massachusetts State Police and DCR for permission to use Parkways for hauling. See Section [01 55 26](#) TRAFFIC REGULATION for related requirements.

1.9 CONTRACTOR USE OF PREMISES

1.9.1 Access to the Work Site

Access to the project site is available for construction traffic as shown on the contract drawings. The Contractor is responsible for maintaining access necessary for its equipment, material, and plant to and from the work area.

1.9.2 Temporary Facilities and Utilities, and Storage Areas

The Contractor shall conform to Section [01 50 00](#) TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS regarding temporary facilities, temporary utilities, and storage areas. Confine all operations (including storage of materials) on Government premises to areas authorized by plans and permits. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

1.9.3 Work Limits

Work shall take place within the limits shown on the contract drawings, at storage areas as indicated in Section [01 50 00](#) TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, and as indicated by the Contracting Officer.

1.9.4 Protection and Security

- a. Protection to Contractor personnel or their equipment cannot be provided at the worksite by the Government.
- b. The Contractor shall protect all its personnel, Government personnel, and the general public from injury.
- c. The Contractor shall conduct all its work so as to prevent injury or unsafe conditions during construction.

1.9.5 Work By Other Contractors

During the performance period of this contract, no other work is anticipated to occur by other contractors.

1.9.6 Emergency Contacts

The Contractor shall provide a list of emergency contacts in the event of

an emergency. The list shall include the contact names, addresses, and telephone numbers. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.9.7 Protection of Existing Structures and Damaged Property

The entire project site is listed on the National Register of Historic Places including landscape, vegetation, circulation, topography and structures, including, but not limited to, the following:

1. Stone wall at the outlet of Leverett Pond
2. Granite Stone Wall at the upstream end of Area 2
3. Brookline Avenue Bridge - between Areas 2 and 3
4. Netherlands Road Bridge - between Areas 3 and 4
5. Bridle Path Bridge - upstream end of Area 5
6. New Granite Faced Culvert at Riverway - downstream end of Area 6
7. Existing puddingstone culvert at Avenue Louis Pasteur at the upstream end of Area 7
8. Pedestrian Bridge near Clemente Field
9. Pedestrian Bridge near War Memorial
10. Agassiz Road Bridge - between Areas 10 and 11
11. Boston Fire Dept. Building - Near Areas 11 and 12
12. Boylston Street/Richardson Bridge - downstream end of Area 12
13. Veteran's War Memorial
14. Victory Gardens

The Contractor shall prosecute the work in a manner which will protect these features and minimize disturbance or risk of damage to these structures, to historic landscape, and surrounding lands. The Contractor shall repair such items damaged in the course of carrying out the work at no additional cost to the Government. All repairs shall match similar existing items in all aspects. All replacements shall be in kind. Repair to any of these features shall be performed in accordance with Secretary of the Interior Standards for the rehabilitation of historic properties (Note; some features are not replaceable).

See Section 02 42 91 HISTORIC, ARCHAEOLOGICAL AND CULTURAL RESOURCES for related requirements.

1.9.8 Contractor's Receipt of Supplies

The Contractor shall be responsible for all arrangements for the receipt of materials and supplies at the job site. Government personnel are not permitted to receive or sign for items delivered to the site.

1.9.9 Daily Clean Up

The Contractor shall at all times keep rubbish from entering surrounding lands and water. Rubbish accumulated at the temporary facilities shall be removed from the premises daily. The Contractor shall not use park trash cans for disposal of construction debris and trash generated by this project.

1.9.10 Government Sanitary Facilities

Toilet facilities are not available on site for Contractor's use. The Contractor shall provide portable toilets for its personnel and subcontractors as specified in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, within the construction fence and not attached to any trees.

1.10 PRE-CONSTRUCTION PHOTOGRAPHIC SURVEY

The Contractor shall perform a pre-construction survey at the project site with the Contracting Officer. This pre-construction survey shall include still photographs and videos in sufficient quantity to fully document the existing condition of all features within the project site which may be impacted by construction activities, such as structures (e.g., bridges, adjacent buildings, etc.), pavement, including parkways used for access and as haul roads, sidewalks, curbing, fencing, vegetation, trees and limbs, street lights, light poles, power poles, traffic signals, pedestrian signals, signs, parking meters, street furniture, newsboxes, trash receptacles, and other pertinent features. A written narrative shall be prepared by the Contractor which organizes and summarizes the findings of the pre-construction survey photographs and videos. The narrative shall separately organize all items owned by the City of Boston, Town of Brookline, Boston Water and Sewer Commission, the Commonwealth of Massachusetts Department of Conservation and Recreation, and individual private owners. Each item shall be identified as "to remain", "to be removed and reset", "to be removed and returned to owner", or "to be demolished or discarded consistent with the contract drawings". The condition of each item shall also be documented. The written narrative, together with the photographs and videos, shall constitute a "Pre-construction Survey Report", which shall be submitted to the Contracting Officer for approval. No on-site work shall be performed until this "Pre-construction Survey Report" has been approved. Damage to items remaining or to be reused caused by the Contractor's operations shall be repaired by the Contractor at no additional expense to the Government.

1.11 LOCATION OF UNDERGROUND FACILITIES

Obtain necessary digging permits prior to start of excavation. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated in locations to be impacted by construction activities. Verify elevations before start of construction.

1.11.1 Notification Prior to Excavation

For excavation work in Massachusetts call Dig Safe at 811, and also call any privately owned utilities in the excavation areas. Notification shall not be earlier than 30 days prior, nor later than 3 days prior, to the planned excavation.

1.12 MAINTAINING CLEANLINESS OF THE PUBLIC WAY

The Contractor shall keep existing and temporary walkways and roadways clear of dirt, mud, and construction debris at all times. Daily sweepings with a vacuum sweeper are required. The Contractor shall construct a stabilized construction access at the ingress and egress to each staging area, maintaining ADA compliance for public ways.

1.13 QUALITY ASSURANCE

- a. All items of work not addressed in the contract documents shall be completed in strict accordance with the manufacturers' specifications.
- b. The Government is not obligated to inspect the Contractor's work, or to protect the Contractor from the consequences of its work. Government inspections are a general examination of the Contractor's conduct and workmanship and are solely for the purpose of the Government. Government-designated Quality Assurance Representatives (QARs) do not have the authority to accept work, nor is a Government inspection to be construed as conclusive.
- c. Government agents including QARs and project engineers are not authorized to change the contract without the written approval of the Contracting Officer; this lack of authority extends to all situations in which the action of these agents could be construed as constituting a change.
- d. The quality of workmanship is subject to audit by Government or Government-designated QARs at any time during the contract. The Contractor shall cooperate fully and provide all information necessary for this audit.
- e. The Contractor shall submit all requests for changes in writing to the Contracting Officer. Do not proceed with changes without possession of written authorization of the Contracting Officer.
- f. The Contractor shall not conceal any work unless the Contracting Officer has approved all items of work which are to be concealed. The Contractor shall notify the Contracting Officer of its intention to conceal work at least 24 hours in advance of concealment.

1.14 GENERAL SAFETY REQUIREMENTS

1.14.1 General

The Contractor shall take all necessary precautions in observing safety regulations in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and shall assume the responsibility to guard against causing of fires and/or explosions and to protect Government property. The Contractor shall perform the work in a manner consistent with security and with fire safety regulations especially with regards to ingress and egress. Temporary closures shall not compromise life safety, security or fire safety.

1.14.2 Contractor's Project Superintendent

The Contractor's project superintendent shall take an active role in enforcing the safety requirements by participation in safety conferences, hazard analysis, tool box meetings, walk-through inspections, correction of violations, etc., and including that of any subcontractor's work.

1.15 ENVIRONMENTAL PROTECTION

To provide for control of all environmental impacts arising from construction activities, the Contractor and its subcontractors, in the performance of this contract, shall comply with Section 01 57 20 ENVIRONMENTAL PROTECTION, and all applicable federal, state, and local laws and regulations concerning environmental protection pollution control and abatement.

1.16 PRECONSTRUCTION CONFERENCE

The Contracting Officer will conduct a preconstruction conference with key Contractor personnel. The purpose of the conference is to review contract requirements and to establish a working relationship between the Contractor's Staff and the U.S. Army Corps of Engineers personnel who will be closely associated with the project. During the conference, the Contracting Officer will inform the Contractor concerning Job Safety, Quality Control, Labor Relations, and Environmental Protection. The Contractor's Superintendent, Quality Control Representative, Site Safety and Health Officer (SSHO), and NFS shall attend this conference.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 REFERENCES (Not Applicable)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Quantity Surveys

Submit originals of all field notes and all other records relating to quantity surveys.

1.3 JOB PAYMENT ITEMS

Payment items for the work of this contract for which contract job payments will be made are listed in the BIDDING SCHEDULE and described below. The job price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

1.4 UNIT PRICE PAYMENT ITEMS

Payment items for the work of this contract on which the contract unit price payments will be made are listed in the BIDDING SCHEDULE and described below. The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items. Submit originals of all field notes and all other records relating to [Quantity Surveys](#).

1.5 BIDDING SCHEDULE - PAYMENT ITEMS

Payment items for the work of this contract on which the contract progress payments will be based are listed in the BIDDING SCHEDULE and are described below. All costs for items of work, which are not specifically mentioned to be included in a particular Bidding Schedule job or unit price payment item, shall be included in the listed item most closely associated with the work involved.

- a. Item Number 0001, "Flood Reduction Excavation in Work Area 1".
- b. Item Number 0003, "Flood Reduction Excavation in Work Area 2".
- c. Item Number 0005, "Flood Reduction Excavation in Work Area 3".
- d. Item Number 0007, "Flood Reduction Excavation in Work Area 4".
- e. Item Number 0009, "Flood Reduction Excavation in Work Area 5".
- f. Item Number 0011, "Flood Reduction Excavation in Work Area 6".
- g. Item Number 0013, "Flood Reduction Excavation in Work Area 7".
- h. Item Number 0015, "Flood Reduction Excavation in Work Area 8".
- i. Item Number 0017, "Flood Reduction Excavation in Work Area 9".
- j. Item Number 0019, "Flood Reduction Excavation in Work Area 10".
- k. Item Number 0021, "Flood Reduction Excavation in Work Area 11".
- l. Item Number 0023, "Flood Reduction Excavation in Work Area 12".

All costs for labor, equipment, and materials for Items Numbers 0001, 0003, 0005, 0007, 0009, 0011, 0013, 0015, 0017, 0019, 0021, and 0023 ("a" through "l" above), for flood reduction excavation, as shown on the contract drawings and in accordance with the specifications. This item includes all work required to complete the flood reduction Excavation for Work Areas 1 through 12, with each work area as a separate Bid Item. Classification, transportation and disposal of the excavated material is included. The landscaping work required in Work Areas 1 through 12 is covered by other Bid Items (see "m" through "x" below).

Unit of Measure: Job.

- m. Item Number 0002, "Landscaping in Work Area 1".
- n. Item Number 0004, "Landscaping in Work Area 2".
- o. Item Number 0006, "Landscaping in Work Area 3".
- p. Item Number 0008, "Landscaping in Work Area 4".
- q. Item Number 0010, "Landscaping in Work Area 5".
- r. Item Number 0012, "Landscaping in Work Area 6".
- s. Item Number 0014, "Landscaping in Work Area 7".
- t. Item Number 0016, "Landscaping in Work Area 8".
- u. Item Number 0018, "Landscaping in Work Area 9".
- v. Item Number 0020, "Landscaping in Work Area 10".
- w. Item Number 0022, "Landscaping in Work Area 11".

- x. Item Number 0024, "Landscaping in Work Area 12".

All costs for labor, equipment, and materials for Item Numbers 0002, 0004, 0006, 0008, 0010, 0012, 0014, 0016, 0018, 0020, 0022, and 0024 ("m" through "X" above) for landscaping, as shown on the contract drawings and in accordance with the specifications. This item includes all work required to complete and maintain the landscaping for Work Areas 1 through 12, with each work area as a separate Bid Item. The flood reduction dredging work required in Work Areas 1 through 12 is covered by other Bid Items (see "a" through "l" above).

Unit of Measure: Job.

- y. Item Number 0025, "Flood Damage Reduction Measures at Fire Station".

All costs for labor, equipment, and materials for the flood damage reduction measures at the Fire Station, as shown on the contract drawings and in accordance with the specifications. This item includes all work required to complete the new concrete flood wall, security fence, pumping station, and associated mechanical and electrical work at the Fire Station.

Unit of Measure: Job.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 32 01

PROJECT SCHEDULE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AACE INTERNATIONAL (AACE)

AACE 29R-03 (2011) Forensic Schedule Analysis

AACE 52R-06 (2006) Time Impact Analysis - As Applied
in Construction

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11 (1995) Administration -- Progress,
Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Scheduler Qualifications; G, RO

Preliminary Project Schedule; G, RO

Initial Project Schedule; G, RO

Periodic Schedule Update; G, RO

1.3 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. The authorized representative must have a minimum of 5-years experience scheduling construction projects similar in size and nature to this project with scheduling software that meets the requirements of this specification. Representative must have a comprehensive knowledge of CPM scheduling principles and application.

PART 2 PRODUCTS

2.1 SOFTWARE

The scheduling software utilized to produce and update the schedules required herein must be capable of meeting all requirements of this specification.

2.1.1 Government Default Software

The Government intends to use Primavera P6.

2.1.2 Contractor Software

Scheduling software used by the contractor must be commercially available from the software vendor for purchase with vendor software support agreements available. The software routine used to create the required sdef file must be created and supported by the software manufacturer.

2.1.2.1 Primavera

If Primavera P6 is selected for use, provide the "xer" export file in a version of P6 importable by the Government system.

2.1.2.2 Other Than Primavera

If the contractor chooses software other than Primavera P6, that is compliant with this specification, provide for the Government's use two licenses, two computers, and training for two Government employees in the use of the software. These computers will be stand-alone and not connected to Government network. Computers and licenses will be returned at project completion.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to FAR Clause 52.236-15, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities. The scheduling of the entire project is required. Fish passage windows shall be included in the schedule. The scheduling of construction is the responsibility of the Contractor. Contractor management personnel must actively participate in its development. Subcontractors and suppliers working on the project must also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool. Use the Critical Path Method (CPM) of network calculation to generate all Project Schedules. Prepare each Project Schedule using the Precedence Diagram Method (PDM).

3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule is the basis for determining contract earnings during each update period and therefore the amount of each progress payment. The aggregate value of all activities coded to a contract CLIN must equal the value of the CLIN.

3.2.1 Activity Cost Loading

Activity cost loading must be reasonable and without front-end loading. Provide additional documentation to demonstrate reasonableness if requested by the Contracting Officer.

3.2.2 Withholdings / Payment Rejection

Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial or periodic schedule updates and subsequent rejection of payment requests until compliance is met.

In the event that the Contracting Officer directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the Contracting Officer may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

3.3.1 Level of Detail Required

Develop the Project Schedule to the appropriate level of detail to address major milestones and to allow for satisfactory project planning and execution. Detail must specify seasonal components and environmental windows. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities may have Original Durations (OD) greater than 20 work days or 30 calendar days.

3.3.3 Procurement Activities

Include activities associated with the critical submittals and their approvals, procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.

3.3.4 Mandatory Tasks

Include the following activities/tasks in the initial project schedule and all updates, as appropriate for the project.

- a. Submission, review and acceptance of SD-01 Preconstruction Submittals (individual activity for each).
- b. Long procurement activities
- c. Submission and approval of O & M manuals.
- d. Submission and approval of as-built drawings.

- e. Submission and approval of DD1354 data and installed equipment lists.
- f. Contractor's pre-final inspection.
- g. Correction of punch list from Contractor's pre-final inspection.
- h. Government's pre-final inspection.
- i. Correction of punch list from Government's pre-final inspection.
- j. Final inspection.

3.3.5 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, environmental permit approvals by State regulators and local regulators, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements, and environmental windows.

3.3.6 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in [ER 1-1-11](#). This exact structure is mandatory. Develop and assign all Activity Codes to activities as detailed herein. A template SDEF compatible schedule backup file is available on the QCS web site: <http://rms.usace.army.mil>.

The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per day
2	RESP	4	Responsible party
3	AREA	4	Area of work
4	MODF	6	Modification Number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of work
7	CATW	1	Category of work
8	FOW	20	Feature of work*
*Some systems require that FEATURE OF WORK values be placed in several activity code fields. The notation shown is for Primavera P6. Refer to the specific software guidelines with respect to the FEATURE OF WORK field requirements.			

3.3.6.1 Workers Per Day (WRKP)

Assign Workers per Day for all field construction or direct work activities, if directed by the Contracting Officer. Workers per day is based on the average number of workers expected each day to perform a task for the duration of that activity.

3.3.6.2 Responsible Party Coding (RESP)

Assign responsibility code for all activities to the Prime Contractor, Subcontractor(s) or Government agency(ies) responsible for performing the activity.

- a. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Property/Equipment (GFP) and Notice to Proceed (NTP) for phasing requirements.
- b. Activities cannot have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE).

3.3.6.3 Area of Work Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities cannot have more than one Work Area Code.

Not all activities are required to be Work Area coded. A lack of Work Area coding indicates the activity is not resource or space constrained.

3.3.6.4 Modification Number (MODF)

Assign a Modification Number Code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer. Key all Code values to the Government's modification numbering system. An activity can have only one Modification Number Code.

3.3.6.5 Bid Item Coding (BIDI)

Assign a Bid Item Code to all activities using the Contract Line Item Schedule (CLIN) to which the activity belongs, even when an activity is not cost loaded. An activity can have only one BIDI Code.

3.3.6.6 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities. Examples of phase of work are procurement phase and construction phase. Each activity can have only one Phase of Work code.

- a. Code proposed fast track design and construction phases proposed to

allow filtering and organizing the schedule by fast track design and construction packages.

- b. If the contract specifies phasing with separately defined performance periods, identify a Phase Code to allow filtering and organizing the schedule accordingly.

3.3.6.7 Category of Work Coding (CATW)

Assign a Category of Work Code to all activities. Category of Work Codes include, but are not limited to construction submittal, procurement, fabrication, weather sensitive installation, non-weather sensitive installation, start-up, and testing activities. Each activity can have no more than one Category of Work Code.

3.3.6.8 Feature of Work Coding (FOW)

Assign a Feature of Work Code to appropriate activities based on the Definable Feature of Work to which the activity belongs based on the approved QC plan.

Definable Feature of Work is defined in Section 01 45 00 QUALITY CONTROL. An activity can have only one Feature of Work Code.

3.3.7 Contract Milestones and Constraints

Milestone activities are to be used for significant project events including, but not limited to, project phasing, project start and end activities, or interim completion dates. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.

Mandatory constraints that ignore or effect network logic are prohibited. No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to the Contracting Officer for approval on a case by case basis.

3.3.7.1 Project Start Date Milestone and Constraint

The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged.

3.3.7.2 End Project Finish Milestone and Constraint

The last activity in the schedule must be a finish milestone titled "End Project."

Constrain the project schedule to the Contract Completion Date in such a way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path. The Government is under no obligation to accelerate Government activities to support a Contractor's early completion. End shall include the establishment period.

3.3.7.3 Interim Completion Dates and Constraints

Constrain contractually specified interim completion dates to show negative

float when the calculated late finish date of the last activity in that phase is later than the specified interim completion date.

3.3.7.3.1 Start Phase

Use a start milestone as the first activity for a project phase. Call the start milestone "Start Phase X" where "X" refers to the phase of work.

3.3.7.3.2 End Phase

Use a finish milestone as the last activity for a project phase. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

3.3.8 Calendars

Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate any contract defined work period such as a 7-day calendar for Government Acceptance activities, concrete cure times, etc. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop seasonal calendar(s) and assign to seasonally affected activities as applicable, including establishment periods and environmental windows.

If an activity is weather sensitive it should be assigned to a calendar showing non-work days on a monthly basis, with the non-work days selected at random across the weeks of the calendar, using the anticipated days provided in the contract clause TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER. Assign non-work days over a seven-day week as weather records are compiled on seven-day weeks, which may cause some of the weather related non-work days to fall on weekends.

3.3.9 Open Ended Logic

Only two open ended activities are allowed: the first activity "NTP Acknowledged" may have no predecessor logic, and the last activity -"End Project" may have no successor logic.

Predecessor open ended logic may be allowed in a time impact analyses upon the Contracting Officer's approval.

3.3.10 Default Progress Data Disallowed

Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent complete and the remaining duration of any activity must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

3.3.11 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project

schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.

3.3.12 Added and Deleted Activities

Do not delete activities from the project schedule or add new activities to the schedule without approval from the Contracting Officer. Activity ID and description changes are considered new activities and cannot be changed without Contracting Officer approval.

3.3.13 Original Durations

Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the Contracting Officer.

3.3.14 Leads, Lags, and Start to Finish Relationships

Lags must be reasonable as determined by the Government and not used in place of realistic original durations, must not be in place to artificially absorb float, or to replace proper schedule logic.

- a. Leads (negative lags) are prohibited.
- b. Start to Finish (SF) relationships are prohibited.

3.3.15 Retained Logic

Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(s) starts and the predecessor activity(s) has not finished (out-of-sequence progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3.16 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to allow for proper schedule management.

3.3.17 Remaining Duration

Update the remaining duration for each activity based on the number of estimated work days it will take to complete the activity. Remaining duration may not mathematically correlate with percentage found under paragraph entitled Percent Complete.

3.3.18 Cost Loading of Closeout Activities

Cost load the "Correction of punch list from Government pre-final inspection" activity(ies) not less than 1 percent of the present contract value. Activity(ies) may be declared 100 percent complete upon the Government's verification of completion and correction of all punch list work identified during Government pre-final inspection(s).

3.3.18.1 As-Built Drawings

If there is no separate contract line item (CLIN) for as-built drawings, cost load the "Submission and approval of as-built drawings" activity not less than \$35,000 or 1 percent of the present contract value, which ever is greater, up to \$200,000. Activity will be declared 100 percent complete upon the Government's approval.

3.3.18.2 O & M Manuals

Cost load the "Submission and approval of O & M manuals" activity not less than \$20,000. Activity will be declared 100 percent complete upon the Government's approval of all O & M manuals.

3.3.19 Anticipated Adverse Weather

Paragraph applicable to contracts with clause entitled TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER. Reflect the number of anticipated adverse weather delays allocated to a weather sensitive activity in the activity's calendar.

3.3.20 Early Completion Schedule and the Right to Finish Early

An Early Completion Schedule is an Initial Project Schedule (IPS) that indicates all scope of the required contract work will be completed before the contractually required completion date.

- a. No IPS indicating an Early Completion will be accepted without being fully resource-loaded (including crew sizes and manhours) and the Government agreeing that the schedule is reasonable and achievable.
- b. The Government is under no obligation to accelerate work items it is responsible for to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the contractor's accelerated work.

3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD/DVD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, then the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

Review comments made by the Government on the schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents.

3.4.1 Preliminary Project Schedule Submission

Within 15 calendar days after the NTP is acknowledged submit the [Preliminary Project Schedule](#) defining the planned operations detailed for the first 90 calendar days for approval. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. The Preliminary Project Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Preliminary Project Schedule forms the

basis for the Initial Project Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, planned submissions of all early design packages, permitting activities and notice requirements for State and local agencies, design review conference activities, and other non-construction activities intended to occur within the first 90 calendar days. Government acceptance of the associated design package(s) and all other specified Program and Plan approvals must occur prior to any planned construction activities. Activity code any activities that are summary in nature after the first 90 calendar days with Bid Item (CLIN) code (BIDI), Responsibility Code (RESP) and Feature of Work code (FOW).

3.4.2 Initial Project Schedule Submission

Submit the [Initial Project Schedule](#) for approval within 42 calendar days after notice to proceed is issued. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. No payment will be made for work items not fully detailed in the Project Schedule.

3.4.3 Periodic Schedule Updates

Update the Project Schedule on a regular basis, monthly at a minimum. Provide a draft Periodic Schedule Update for review at the schedule update meetings as prescribed in the paragraph PERIODIC SCHEDULE UPDATE MEETINGS. These updates will enable the Government to assess Contractor's progress.

- a. Update information including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete is subject to the approval of the Government at the meeting.
- b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for an activity start or finish.

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1 Data CD/DVDs

Provide two sets of data CD/DVDs containing the current project schedule and all previously submitted schedules in the format of the scheduling software (e.g. .xer). Also include on the data CD/DVDs the Narrative Report and all required Schedule Reports. Label each CD/DVD indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file name. Each schedule must have a unique file name and use project specific settings.

3.5.2 Narrative Report

Provide a Narrative Report with each schedule submission. The Narrative Report is expected to communicate to the Government the thorough analysis of the schedule output and the plans to compensate for any problems, either current or potential, which are revealed through that analysis. Include the following information as minimum in the Narrative Report:

- a. Identify and discuss the work scheduled to start in the next update period.
- b. A description of activities along the two most critical paths where the total float is less than or equal to 20 work days.
- c. A description of current and anticipated problem areas or delaying factors and their impact and an explanation of corrective actions taken or required to be taken.
- d. Identify and explain why activities based on their calculated late dates should have either started or finished during the update period but did not.
- e. Identify and discuss all schedule changes by activity ID and activity name including what specifically was changed and why the change was needed. Include at a minimum new and deleted activities, logic changes, duration changes, calendar changes, lag changes, resource changes, and actual start and finish date changes.
- f. Identify and discuss out-of-sequence work.

3.5.3 Schedule Reports

The format, filtering, organizing and sorting for each schedule report will be as directed by the Contracting Officer. Typically, reports contain Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. Provide the reports electronically in .pdf format. Provide three set of hardcopy reports. The following lists typical reports that will be requested:

3.5.3.1 Activity Report

List of all activities sorted according to activity number.

3.5.3.2 Logic Report

List of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.3.4 Earnings Report by CLIN

A compilation of the Total Earnings on the project from the NTP to the data date, which reflects the earnings of activities based on the agreements made in the schedule update meeting defined herein. Provided a complete schedule update has been furnished, this report serves as the basis of determining progress payments. Group activities by CLIN number and sort by activity number. Provide a total CLIN percent earned value, CLIN percent complete, and project percent complete. The printed report must contain the following for each activity: the Activity Number, Activity Description,

Original Budgeted Amount, Earnings to Date, Earnings this period, Total Quantity, Quantity to Date, and Percent Complete (based on cost).

3.5.3.5 Schedule Log

Provide a Scheduling/Leveling Report generated from the current project schedule being submitted.

3.5.4 Network Diagram

The Network Diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.4.3 Critical Path

Show all activities on the critical path. The critical path is defined as the longest path.

3.5.4.4 Banding

Organize activities using the WBS or as otherwise directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by major elements of work, category of work, work area and/or responsibility.

3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram

With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates, and 2) Earned Value to-date.

3.6 PERIODIC SCHEDULE UPDATE

3.6.1 Periodic Schedule Update Meetings

Conduct periodic schedule update meetings for the purpose of reviewing the proposed Periodic Schedule Update, Narrative Report, Schedule Reports, and progress payment. Conduct meetings at least monthly within five days of the proposed schedule data date. Provide a computer with the scheduling software loaded and a projector which allows all meeting participants to view the proposed schedule during the meeting. The Contractor's authorized scheduler must organize, group, sort, filter, perform schedule revisions as needed and review functions as requested by the Contractor and/or Government. The meeting is a working interactive exchange which allows the Government and Contractor the opportunity to review the updated schedule on

a real time and interactive basis. The meeting will last no longer than 8 hours. Provide a draft of the proposed narrative report and schedule data file to the Government a minimum of two workdays in advance of the meeting. The Contractor's Project Manager and scheduler must attend the meeting with the authorized representative of the Contracting Officer. Superintendents, foremen and major subcontractors must attend the meeting as required to discuss the project schedule and work. Following the periodic schedule update meeting, make corrections to the draft submission. Include only those changes approved by the Government in the submission and invoice for payment.

3.6.2 Update Submission Following Progress Meeting

Submit the complete [Periodic Schedule Update](#) of the Project Schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 work days after the periodic schedule update meeting.

3.7 WEEKLY PROGRESS MEETINGS

Conduct a weekly meeting with the Government and non-Federal Sponsors (or as otherwise mutually agreed to) between the meetings described in paragraph entitled PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. Use the current approved schedule update for the purposes of this meeting and for the production and review of reports. At the weekly progress meeting, address the status of RFIs, RFPs and Submittals.

3.8 REQUESTS FOR TIME EXTENSIONS

Provide a justification of delay to the Contracting Officer in accordance with the contract provisions and clauses for approval within 10 days of a delay occurring. Also prepare a time impact analysis for each Government request for proposal (RFP) to justify time extensions.

3.8.1 Justification of Delay

Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the Government. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension and the schedule fragnet becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer.

3.8.2 Time Impact Analysis (Prospective Analysis)

Prepare a time impact analysis for approval by the Contracting Officer based on industry standard [ACEC 52R-06](#). Utilize a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis. If Contracting Officer determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the Contracting Officer, no other changes may be incorporated into the schedule being used to justify the time impact.

3.8.3 Forensic Schedule Analysis (Retrospective Analysis)

Prepare an analysis for approval by the Contracting Officer based on industry standard [ACE 29R-03](#).

3.8.4 Fragmentary Network (Fragnet)

Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be approved by the Contracting Officer prior to incorporation into the project schedule.

3.8.5 Time Extension

The Contracting Officer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.8.6 Impact to Early Completion Schedule

No extended overhead will be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

3.9 FAILURE TO ACHIEVE PROGRESS

Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the contract, the Contracting Officer may require provision of a written recovery plan for approval. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra work days, etc.

3.9.1 Artificially Improving Progress

Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly work hour changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

3.9.2 Failure to Perform

Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in an interim and final unsatisfactory performance rating and/or may result in corrective action directed by the Contracting Officer pursuant to FAR 52.236-15 Schedules for Construction Contracts, FAR 52.249-10 Default (Fixed-Price Construction), and other contract provisions.

3.9.3 Recovery Schedule

Should the Contracting Officer find it necessary, submit a recovery schedule pursuant to FAR 52.236-15 Schedules for Construction Contracts.

3.10 OWNERSHIP OF FLOAT

Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, may not be considered for the exclusive use of either the Government or the Contractor including activity and/or project float. Activity float is the number of work days that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of work days between the projected early finish and the contract completion date milestone.

3.11 TRANSFER OF SCHEDULE DATA INTO RMS/QCS

Import the schedule data into the Quality Control System (QCS) and export the QCS data to the Government. This data is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and matching electronic export from QCS of the application for progress payment.

3.12 PRIMAVERA P6 MANDATORY REQUIREMENTS

If Primavera P6 is being used, request a backup file template (.xer) from the Government, if one is available, prior to building the schedule. The following settings are mandatory and required in all schedule submissions to the Government:

- a. Activity Codes must be Project Level, not Global or EPS level.
- b. Calendars must be Project Level, not Global or Resource level.
- c. Activity Duration Types must be set to "Fixed Duration & Units".
- d. Percent Complete Types must be set to "Physical".
- e. Time Period Admin Preferences must remain the default "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days.
- f. Set Schedule Option for defining Critical Activities to "Longest Path".
- g. Set Schedule Option for defining progressed activities to "Retained Logic".

- h. Set up cost loading using a single lump sum labor resource. The Price/Unit must be \$1/hr, Default Units/Time must be "8h/d", and settings "Auto Compute Actuals" and "Calculate costs from units" selected.
- i. Activity ID's must not exceed 10 characters.
- j. Activity Names must have the most defining and detailed description within the first 30 characters.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

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-- End of Section Table of Contents --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to start of construction (work) or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Accident Prevention Plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Include assemblies or portions of assemblies that are to be incorporated into the project and those that will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to

a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within two years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements shall be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further qualify the orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS) concerning impedances, hazards and safety precautions.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G, RO

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.4.1.1 Approval Codes

a. Construction Division {"AO" (Area Office), "RO" (Resident Office), or "PO" (Project Office) Reviewer}: An "AO", "RO", or "PO" in column "f" indicates that the submittal review action is by New England District Construction Division. Send all such submittals to the project Resident or Area Engineer, as applicable.

b. Engineering Division {"DO" (District Office) Reviewer}: A "DO" on the attached submittal register, column "f" indicates that the submittal review action is by the New England District, Engineering Division, or other organization in the District Office. Send all such submittals to the project Resident or Area Engineer for distribution to the appropriate approving authority.

d. Government acceptance is required for submittals with a "G, A" designation.

1.4.2 Information Only

Submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.4.3 Sustainability Reporting Submittals (S)

Submittals for Guiding Principle Validation (GPV) or Third Party Certification (TPC) are indicated with an "S" designation. Submit the information required by the technical sections that demonstrates compliance with the sustainable requirement, and for inclusion in the Sustainability eNotebook if required by Section 01 33 29 SUSTAINABILITY REPORTING. A full submittal for an item may be provided under another SD; however, for the "S" submittal, only provide that portion of the submittal that demonstrates compliance with the sustainable requirement. If the sustainable submittal does require Government Approval, it may be tagged under another SD with a "G."

Schedule submittals for these items throughout the course of construction as provided; do not wait until closeout.

1.5 PREPARATION

1.5.1 Transmittal Form

Use the attached sample transmittal form (ENG Form 4025) for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor and are included in the QCS software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.5.2 Source Drawings for Shop Drawings

The entire set of Source Drawing files (DWG) will not be provided to the Contractor. Only those requested by the Contractor to prepare shop drawings may be provided. Request the specific Drawing Number only for the preparation of Shop Drawings. These drawings may only be provided after award.

1.5.2.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable

attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic Source Drawing files are not construction documents. Differences may exist between the Source Drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic Source Drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished Source Drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic Source Drawing files for use in producing construction data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

1.6 QUANTITY OF SUBMITTALS

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. In addition to the electronic submittal, provide seven hard copies of the submittals. Compile the submittal file as a single, complete document, to include the Transmittal Form described within. Name the electronic submittal file specifically according to its contents, coordinate the file naming convention with the Contracting Officer. Electronic files must be of sufficient quality that all information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature, or scan of a signature.

Email electronic submittal documents fewer than 10MB to an email address as directed by the Contracting Officer. Provide electronic documents over 10MB on an optical disc, or through an electronic file sharing system such as the AMRDEC SAFE Web Application located at the following website:

<https://safe.amrdec.army.mil/safe/>.

Up to two additional hard copies of any submittal may be requested at the discretion of the Contracting Officer, at no additional cost to the Government.

1.7 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications, will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work, and does not relieve the Contractor of the requirement to furnish samples

for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.8 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.8.1 Considering Variations

Discussion with Contracting Officer prior to submission, after consulting with the DOR, will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation that results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.8.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals that include proposed deviations requested by the Contractor. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.8.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.8.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.9 SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is

provided as an attachment. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 01 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM). The Government will provide the initial submittal register in electronic format with the following fields completed, to the extent that will be required by the Government during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.9.1 Use of Submittal Register

Submit submittal register. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.9.2 Contractor Use of Submittal Register

Update the following fields with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.9.3 Approving Authority Use of Submittal Register

Update the following fields.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.9.4 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.10 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A".
- c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.
- d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register".

1.11 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

- a. Note date on which submittal was received.
- b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. Two copies of the approved submittal will be retained by the Contracting Officer and the remaining copies of the submittal will be returned to the Contractor.

1.11.1 Review Notations

Contracting Officer review will be completed within 21 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
- c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.
- d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.12 DISAPPROVED SUBMITTALS

The Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved. Submittals requiring resubmittal shall be resubmitted within 14 calendar days unless additional time is granted by the Government.

1.13 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.15 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.16 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

August 02, 2018

CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s)
SIGNATURE: _____
TITLE: _____
DATE: _____

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SUBMITTAL REGISTER											CONTRACT NO.						
TITLE AND LOCATION Muddy River Flood Damage Reduction, Boston and Brookline, MA						CONTRACTOR											
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEWER	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 11 00	SD-01 Preconstruction Submittals														
			Pre-Construction Photographic Survey	1.10	G RO												
			Hauling Plan	1.8	G RO												
			SD-07 Certificates														
			Request Application	1.7.1	G RO												
		01 22 00	SD-05 Design Data														
			Quantity Surveys	1.4													
		01 32 01	SD-01 Preconstruction Submittals														
			Project Scheduler Qualifications	1.3	G RO												
			Preliminary Project Schedule	3.4.1	G RO												
			Initial Project Schedule	3.4.2	G RO												
			Periodic Schedule Update	3.6.2	G RO												
		01 33 00	SD-01 Preconstruction Submittals														
			Submittal Register	1.9	G RO												
		01 33 29	SD-01 Preconstruction Submittals														
			Documentation Requirements	1.5	G RO												
		01 35 26	SD-01 Preconstruction Submittals														
			Accident Prevention Plan (APP)	1.7	G RO												
			SD-06 Test Reports														
			Monthly Exposure Reports	1.4													
			Notifications and Reports	1.12													
			Accident Reports	1.12.2	G RO												
			LHE Inspection Reports	1.12.3													
			SD-07 Certificates														
			Crane Operators/Riggers	1.6.1.5													

SUBMITTAL REGISTER											CONTRACT NO.						
TITLE AND LOCATION Muddy River Flood Damage Reduction, Boston and Brookline, MA						CONTRACTOR											
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEWER	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY						REMARKS
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		01 35 26	Standard Lift Plan	1.7.2.1	G RO												
			Critical Lift Plan	1.7.2.2	G RO												
			Activity Hazard Analysis (AHA)	1.8													
			Hot Work Permit	1.9.1													
			Certificate of Compliance	1.12.4													
			License Certificates														
		01 45 00	SD-01 Preconstruction Submittals														
			Contractor Quality Control (CQC)	3.2	G RO												
			Plan														
			SD-06 Test Reports														
			Verification Statement	3.9													
		01 50 00	SD-01 Preconstruction Submittals														
			Site Plan	1.3	G RO												
		01 55 26	SD-01 Preconstruction Submittals														
			Traffic Control Plan		G DO												
		01 57 16	SD-01 Preconstruction Submittals														
			Pest Control Work Plan		G RO												
			SD-03 Product Data														
			EPA-approved Pesticide Label		G RO												
			SD-11 Closeout Submittals														
			Weekly Data Sheets		G RO												
			Monthly Written Summary		G RO												
			Quarterly Map		G RO												
		01 57 20	SD-01 Preconstruction Submittals														
			Environmental Protection Plan	1.7	G DO												

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TITLE AND LOCATION Muddy River Flood Damage Reduction, Boston and Brookline, MA						CONTRACTOR											
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		01 57 20	Surface Water and Wastewater	1.8	G DO												
			Quality Monitoring Plan														
			SD-06 Test Reports														
			Test Results	3.3.3.1													
		01 57 23	SD-07 Certificates														
			Mill Certificate or Affidavit	2.1.3													
		01 71 23	SD-07 Certificates														
			Qualifications	1.3													
			SD-06 Test Reports														
			As-Built Cross-Sections	1.6	G RO												
		01 74 19	SD-01 Preconstruction Submittals														
			Waste Management Plan	1.5	G RO												
		01 78 00	SD-11 Closeout Submittals														
			As-Built Drawings	1.2.1	G DO												
		01 78 23	SD-10 Operation and Maintenance														
			Data														
			O&M Database	1.3	G RO												
			Training Plan	3.1.1	G RO												
			Training Outline	3.1.3	G RO												
			Training Content	3.1.2	G RO												
			SD-11 Closeout Submittals														
			Validation of Training Completion	3.1.5	G RO												
		02 40 00	SD-02 Shop Drawings														
			Design Details - Diversion		G DO												
			Emergency Operations Plan		G DO												
			SD-05 Design Data														

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		02 40 00	Calculations - Diversion Structures		G DO												
			SD-06 Test Reports														
			Subsurface Investigation of Diversion System		G DO												
		03 30 53	SD-01 Preconstruction Submittals														
			Mock-Up Panel Written Notification	1.5.1.2	G RO												
			SD-02 Shop Drawings														
			Installation Drawings	1.4	G RO												
			SD-03 Product Data														
			Air-Entraining Admixture	2.2.3.1													
			Water-Reducing or Retarding Admixture	2.2.3.2													
			Curing Materials	2.2.11													
			Expansion Joint Filler Strips, Premolded	2.2.6													
			Joint Sealants - Field Molded Sealants	2.2.7													
			Conveying and Placing Concrete	3.2													
			Formwork	2.2.8													
			Mix Design Data	2.3	G RO												
			Ready-Mix Concrete	2.3													
			Curing Compound	2.4.1													
			Mechanical Reinforcing Bar Connectors	2.2.5													

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		03 30 53	SD-04 Samples														
			Mock-Up Panel	1.5.1.2	G RO												
			SD-06 Test Reports														
			Aggregates	2.2.2													
			Concrete Mixture Proportions	2.1.3	G RO												
			Compressive Strength Testing	3.8.3	G RO												
			Slump	3.8.3	G RO												
			Air Content	3.8.3													
			Water	2.2.4													
			SD-07 Certificates														
			Cementitious Materials	2.2.1													
			Pozzolan														
			CPG for recycled materials or appropriate Waiver Form														
			Aggregates	2.2.2													
			Delivery Tickets	2.3													
			SD-08 Manufacturer's Instructions														
			Curing Compound	2.4.1													
		03 42 13	SD-01 Preconstruction Submittals														
			Quality Control Procedures	1.3.2.2													
			SD-02 Shop Drawings														
			Standard Precast Units	2.1.1	G RO												
			Custom-Made Precast Units	2.1.2	G RO												
			SD-03 Product Data														
			Standard Precast Units	2.1.1													
			Proprietary Precast Units	2.1.3													

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		03 42 13	Embedded Items	3.1.3													
			Accessories	2.2.6													
			SD-05 Design Data														
			Design Calculations	2.1.2	G RO												
			Concrete Mix Proportions	2.1.5.1													
			SD-06 Test Reports														
			Test Reports	1.3.2.4													
			SD-07 Certificates														
			Quality Control Procedures	1.3.2.2													
			SD-11 Closeout Submittals														
			Recycled Content for Fly Ash and	2.2.1													
			Pozzolan														
			Recycled Content for Ground Iron	2.2.1													
			Blast-Furnace Slag														
			Recycled Content for Silica Fume	2.2.1													
			Recycled Content for Synthetic	2.2.1													
			Fiber Reinforcement														
			Recycled Content for steel	2.2.1													
		07 84 00	SD-02 Shop Drawings														
			Firestopping System	2.1	G RO												
			SD-03 Product Data														
			Firestopping Materials	2.2	G RO												
			SD-06 Test Reports														
			Inspection	3.3	G RO												
			SD-07 Certificates														
			Inspector Qualifications														

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		07 84 00	Firestopping Materials	2.2													
			Installer Qualifications	1.5.1	G RO												
		22 13 29	SD-02 Shop Drawings														
			Detail Drawings	1.4.3	G DO												
			SD-03 Product Data														
			Materials and Equipment	2.1	G DO												
			Spare Parts	1.6													
			Installation Instruction Manual														
			SD-06 Test Reports														
			Field Test Report		G DO												
			Installation and Start-Up	1.4.2													
			Engineer														
			Performance Test Reports	3.4.3													
			SD-10 Operation and Maintenance														
			Data														
			Operating and Maintenance	3.5	G RO												
			Manuals														
		26 05 19	SD-03 Product Data														
			Wire and Cable	2.1.1													
			Conductors	2.1.2.1													
			Cable Manufacturing Data	3.1													
			SD-06 Test Reports														
			Test Report(s), Inspection	3.2	G RO												
			Report(s), and Verification														
			Report(s)														
		26 20 00	SD-02 Shop Drawings														

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		26 20 00	Marking strips	3.1.8.1	G DO												
			SD-03 Product Data														
			Combination motor controllers	2.6	G DO												
			SD-06 Test Reports														
			600-volt wiring test	3.4.2													
			SD-10 Operation and Maintenance														
			Data														
			Electrical Systems	1.5.1	G												
		31 00 00	SD-01 Preconstruction Submittals														
			Dewatering Work Plan	1.6	G DO												
			Excavation Work Plans	1.7	G DO												
			SD-04 Samples														
			Gravel Borrow	2.7	G RO												
			3/4-Inch Crushed Stone	2.7	G RO												
			Stone Dust	2.7	G RO												
			Dense-Graded Crushed Stone	2.7	G RO												
			Sand	2.7	G RO												
			SD-06 Test Reports														
			Testing	3.12													
			Borrow Site Testing	2.1													
			SD-07 Certificates														
			Testing	3.12													
		31 01 00	SD-01 Preconstruction Submittals														
			Qualifications	1.4	G RO												
			Temporary Excavation Support		G DO												
			Plan														

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		31 01 00	Construction Action Plan		G RO												
			SD-02 Shop Drawings														
			Estimates of the Lateral and Vertical Displacements		G RO												
		31 05 19	SD-03 Product Data														
			Thread	2.1.2	G DO												
			Manufacturing Quality Control	2.2	G DO												
			Sampling and Testing														
			SD-04 Samples														
			Quality Assurance Samples and Tests	3.1	G DO												
			SD-07 Certificates														
			Geotextile	2.1.1	G DO												
		31 11 00	SD-01 Preconstruction Submittals														
			Tree Removal and Grubbing Plan		G DO												
		31 41 16	SD-02 Shop Drawings														
			Metal Sheet Piling	2.1	G RO												
			SD-03 Product Data														
			Driving	3.2.2.2													
			Pile Driving Equipment	3.2.1	G RO												
			Pulling and Redriving		G RO												
			SD-06 Test Reports														
			Materials Tests	2.3.1													
			SD-07 Certificates														
			Material Certificates	1.5.1	G RO												
			SD-11 Closeout Submittals														

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		31 41 16	Pile Driving Record	3.4													
		32 12 17	SD-01 Preconstruction Submittals														
			Mix Design	2.1.2	G DO												
			SD-06 Test Reports														
			Test Results	3.6.4	G DO												
			SD-07 Certificates														
			Waybills and Delivery Tickets	3.3.3													
		32 16 13	SD-03 Product Data														
			Concrete	2.1													
			Detectable Warning Panels														
			SD-04 Samples														
			Detectable Warning Panels														
			SD-06 Test Reports														
			Field Quality Control	3.9													
			SD-08 Manufacturer's Instructions														
			Detectable Warning Panels														
		32 17 24	SD-03 Product Data														
			Equipment	1.5	G RO												
			Composition Requirements	2.2.1													
			Qualifications	1.8													
			SD-06 Test Reports														
			Sampling and Testing	2.3													
			SD-07 Certificates														
			Volatile Organic Compound	2.2.3													
			(VOC)														
		32 31 13	SD-02 Shop Drawings														

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		32 31 13	Fence Assembly		G DO												
			Security Fence	2.1	G DO												
			Location of Gate, Corner, End, and Pull Posts	3.15.1	G DO												
			Gate Assembly		G DO												
			Gate Hardware and Accessories	2.16	G DO												
			SD-03 Product Data														
			Fence Assembly														
			Security Fence	2.1	G DO												
			Gate Assembly														
			Gate Hardware and Accessories	2.16													
			SD-07 Certificates														
			Zinc Coating	2.3													
			PVC coating	2.5													
		32 84 24	SD-03 Product Data														
			Material Data Sheets		G RO												
			SD-04 Samples														
			Coir Logs	2.1	G RO												
			Timber Stakes	2.2	G RO												
		32 92 19	SD-01 Preconstruction Submittals														
			Watering Plan		G DO												
			SD-03 Product Data														
			Wood Cellulose Fiber Mulch	2.5.1	G DO												
			Fertilizer	2.4	G DO												
			SD-06 Test Reports														
			Topsoil Composition Tests		G DO												

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		32 92 19	SD-07 Certificates														
			Seed	2.1	G DO												
		32 93 00	SD-01 Preconstruction Submittals														
			Habitat Restoration Specialist		G DO												
			Arborist		G DO												
			Landscape Architect		G DO												
			Work Plan		G DO												
			SD-03 Product Data														
			Turf Reinforcement Mat	2.2.9	G DO												
			Turf Reinforcement Mat Staples		G DO												
			Mulch	2.2.8	G DO												
			Fertilizer	2.2.5	G DO												
			SD-04 Samples														
			Mulch	2.2.8	G DO												
			SD-06 Test Reports														
			Topsoil	2.2	G DO												
			Leaf Compost		G DO												
			Nursery Certifications		G DO												
			Condition Report	3.6.1													
		32 94 00	SD-01 Preconstruction Submittals														
			Invasive Species Control		G DO												
			Supervisor														
			Invasive Species Control Work		G DO												
			Plan														
		33 01 00	SD-01 Preconstruction Submittals														

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		33 01 00	Resumes of the Geotechnical Engineer														
			Instrumentation Plan														
			Procedure for Installation														
			SD-03 Product Data														
			Specified Instruments														
			Factory Calibration														
			Quality Assurance Checklist														
			Warranty for each Portable Readout Unit														
			Installation Record Sheet														
			As-built Instrument Location Plans														
			SD-07 Certificates														
			Manufacturer's Test Equipment Certification		G RO												
		33 11 00	SD-03 Product Data														
			Pipe, Fittings, Joints and Couplings	2.2	G RO												
			SD-07 Certificates														
			Pipe, Fittings, Joints and Couplings	2.2													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	3.1.1													
		35 31 19	SD-01 Preconstruction Submittals														
			Source		G DO												

[illegible]

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE <small>For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.</small>						DATE		TRANSMITTAL NO.	
SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS <small>(This section will be initiated by the contractor)</small>									
TO:			FROM:		CONTRACT NO.		CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____		
SPECIFICATION SEC. NO. <small>(Cover only one section with each transmittal)</small>			PROJECT TITLE AND LOCATION			THIS TRANSMITTAL IS FOR: <small>(Check one)</small> <input type="checkbox"/> FIO <input type="checkbox"/> GA <input type="checkbox"/> DA <input type="checkbox"/> CR <input type="checkbox"/> DA/CR <input type="checkbox"/> DA/GA			
ITEM NO. <small>(See Note 3)</small> a.	DESCRIPTION OF SUBMITTAL ITEM <small>(Type size, model number/etc.)</small> b.		SUBMITTAL TYPE CODE <small>(See Note 8)</small> c.	NO. OF COPIES d.	CONTRACT DOCUMENT REFERENCE SPEC. PARA. NO. DRAWING SHEET NO. e. f.		CONTRACTOR REVIEW CODE g.	VARIATION <small>Enter "Y" if requesting a variation (See Note 6)</small> h.	USACE ACTION CODE <small>(Note 9)</small> i.
REMARKS					I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.				
					NAME OF CONTRACTOR			SIGNATURE OF CONTRACTOR	
SECTION II - APPROVAL ACTION									
ENCLOSURES RETURNED <small>(List by item No.)</small>			NAME AND TITLE OF APPROVING AUTHORITY			SIGNATURE OF APPROVING AUTHORITY		DATE	

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each Transmittal shall be numbered consecutively. The Transmittal Number typically includes two parts separated by a dash (-). The first part is the specification section number. The second part is a sequential number for the submittals under that spec section. If the Transmittal is a resubmittal, then add a decimal point to the end of the original Transmittal Number and begin numbering the resubmittal packages sequentially after the decimal.
3. The "Item No." for each entry on this form will be the same "Item No." as indicated on ENG FORM 4288-R.
4. Submittals requiring expeditious handling will be submitted on a separate ENG Form 4025-R.
5. Items transmitted on each transmittal form will be from the same specification section. Do not combine submittal information from different specification sections in a single transmittal.
6. If the data submitted are intentionally in variance with the contract requirements, indicate a variation in column h, and enter a statement in the Remarks block describing the detailed reason for the variation.
7. ENG Form 4025-R is self-transmitting - a letter of transmittal is not required.
8. When submittal items are transmitted, indicate the "Submittal Type" (*SD-01 through SD-11*) in column c of Section I.
 Submittal types are the following:

SD-01 - Preconstruction	SD-02 - Shop Drawings	SD-03 - Product Data	SD-04 - Samples	SD-05 - Design Data	SD-06 - Test Reports
SD-07 - Certificates	SD-08 - Manufacturer's Instructions	SD-09 - Manufacturer's Field Reports	SD-10 - O&M Data	SD-11 - Closeout	
9. For each submittal item, the Contractor will assign Submittal Action Codes in column g of Section I. The U.S. Army Corps of Engineers approving authority will assign Submittal Action Codes in column i of Section I. The Submittal Action Codes are:

A -- Approved as submitted. B -- Approved, except as noted on drawings. Resubmission not required. C -- Approved, except as noted on drawings. Refer to attached comments. Resubmission required. D -- Will be returned by separate correspondence. E -- Disapproved. Refer to attached comments.	F -- Receipt acknowledged. X -- Receipt acknowledged, does not comply with contract requirements, as noted. G -- Other action required (<i>Specify</i>) K -- Government concurs with intermediate design. (<i>For D-B contracts</i>) R -- Design submittal is acceptable for release for construction. (<i>For D-B contracts</i>)
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10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

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SECTION 01 33 29

SUSTAINABILITY REPORTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF ENERGY (DOE)

ISWG Guiding Principles (2008) High Performance and Sustainable Buildings Guidance

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

48 CFR 23 Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace

1.2 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Documentation Requirements; G, R0

Submit documentation that proves compliance with the listed requirement of this section.

1.3 SUMMARY

This specification includes general requirements and procedures for this project to be constructed and documented per the federally mandated "Guiding Principles" (GP) and other requirements identified in this specification.

1.4 LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

Many products listed in 40 CFR 247 and 48 CFR 23 have been designated or proposed by EPA and USDA to include recycled, recovered and biobased materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office

products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled, recovered and biobased materials and that these products be recycled when no longer needed.

1.5 DOCUMENTATION REQUIREMENTS

Incorporate the following **ISWG Guiding Principles** Requirements into project construction and provide documentation that proves compliance with the listed requirements. The items below are organized according to the **ISWG Guiding Principles**.

1.5.1 Landfill Disposal

Divert construction debris from landfill disposal in accordance with Section **01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT**. Provide the following documentation:

- a. Documentation showing total amount of construction debris diverted from landfill as a percentage of all construction debris on the project.
- b. Include project's Construction Waste Management Plan (see Section **01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT**) and all dumpster haul tickets.

1.5.2 Energy Efficient Equipment

Provide only energy-using equipment that is Energy Star rated, or has the Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide most efficient equipment available. Provide only energy using equipment that meets FEMP requirements for low standby power consumption. Energy efficient equipment can be found at: <http://www1.eere.energy.gov/femp/> and <http://www.energystar.gov/>. Provide the following documentation:

Proof that equipment is labeled energy efficient and complies with the cited requirements.

1.5.3 Recycled Content

Provide materials on this project with aggregated total recycled content equal to or greater than 10 percent. In addition, comply with **40 CFR 247**. Refer to for assistance identifying products cited in **40 CFR 247**. Provide the following documentation:

- a. Total amount of recycled content contained in building materials as a percentage of total cost of all building materials on the project (mechanical, electrical, and plumbing components, fire protection equipment and transportation are excluded).
- b. Manufacturers documents stating the recycled content by material, or written justification for claiming one of the exceptions allowed under RCRA 6002.
- c. Substitutions: Contractor may submit for Government approval, proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions,

submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.

1.5.4 Bio-Based Products

Utilize products and material made from biobased materials to the maximum extent possible without jeopardizing the intended end use or detracting from the overall quality delivered to the end user. Use only supplies and materials of a type and quality that conform to applicable specifications and standards.

Biobased products that are designated for preferred procurement under the USDA BioPreferred Program must meet the required minimum biobased content. Refer to <http://www.biopreferred.gov> for the product categories and BioPreferred Catalog. Provide the following documentation:

- a. For biobased products used on this project, provide biobased product content percentage and biobased source of material. Indicate name of the manufacturer, cost of each product and the use of each product on this project.
- b. For products that meet USDA Biopreferred Program, provide documentation of USDA Biopreferred label.
- c. The use of vegetable based hydraulic fluid for construction equipment used on this project is required.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUSTAINABILITY COORDINATION

Provide sustainability focus and coordination at the following meetings to achieve sustainability goals. Contractor's designated sustainability professional responsible for GP documentation shall participate in the following meetings to coordinate documentation completion.

- a. Pre-Construction Conference: Discuss the following: sustainability actions and documentation requirements, construction submittal requirements and schedule, and individuals responsible for achieving each Guiding Principle Requirement.
- b. Construction Progress Meetings: Review GP sustainability requirements with project team including contractor and sub-contractor representatives.

-- End of Section --

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GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE A10.44	(2014) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations
ASSE/SAFE Z244.1	(2003; R 2014) Control of Hazardous Energy Lockout/Tagout and Alternative Methods
ASSE/SAFE Z359.0	(2012) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
ASSE/SAFE Z359.11	(2014) Safety Requirements for Full Body Harnesses
ASSE/SAFE Z359.12	(2009) Connecting Components for Personal Fall Arrest Systems
ASSE/SAFE Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ASSE/SAFE Z359.14	(2014) Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
ASSE/SAFE Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems
ASSE/SAFE Z359.2	(2007) Minimum Requirements for a Comprehensive Managed Fall Protection Program
ASSE/SAFE Z359.3	(2007) Safety Requirements for Positioning and Travel Restraint Systems
ASSE/SAFE Z359.4	(2013) Safety Requirements for

Assisted-Rescue and Self-Rescue Systems,
Subsystems and Components

ASSE/SAFE Z359.6 (2009) Specifications and Design
Requirements for Active Fall Protection
Systems

ASSE/SAFE Z359.7 (2011) Qualification and Verification
Testing of Fall Protection Products

ASME INTERNATIONAL (ASME)

ASME B30.20 (2013; INT Oct 2010 - May 2012)
Below-the-Hook Lifting Devices

ASME B30.22 (2010) Articulating Boom Cranes

ASME B30.26 (2015; INT Jun 2010 - Jun 2014) Rigging
Hardware

ASME B30.3 (2012) Tower Cranes

ASME B30.5 (2014) Mobile and Locomotive Cranes

ASME B30.8 (2010) Floating Cranes and Floating
Derricks

ASME B30.9 (2014; INT Feb 2011 - Nov 2013) Slings

ASTM INTERNATIONAL (ASTM)

ASTM F855 (2015) Standard Specifications for
Temporary Protective Grounds to Be Used on
De-energized Electric Power Lines and
Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048 (2003) Guide for Protective Grounding of
Power Lines

IEEE C2 (2017) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (2013) Standard for Portable Fire
Extinguishers

NFPA 241 (2013; Errata 2015) Standard for
Safeguarding Construction, Alteration, and
Demolition Operations

NFPA 51B (2014) Standard for Fire Prevention During
Welding, Cutting, and Other Hot Work

NFPA 70 (2017) National Electrical Code

NFPA 70E (2015; ERTA 1 2015) Standard for
Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements
Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards
29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag
Out)
29 CFR 1910.333 Selection and Use of Work Practices
29 CFR 1915.89 Control of Hazardous Energy
(Lockout/Tags-Plus)
29 CFR 1926 Safety and Health Regulations for
Construction
29 CFR 1926.1400 Cranes and Derricks in Construction
29 CFR 1926.16 Rules of Construction
29 CFR 1926.450 Scaffolds
29 CFR 1926.500 Fall Protection

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA's Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to

take prompt corrective measures with regard to such hazards.

1.2.4 Competent Person, Excavation/Trenching

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.5 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSE/SAFE Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.6 Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q, and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and also has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented and include experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented, minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

1.2.7 Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

1.2.8 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and

confined space entry.

1.2.9 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.10 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.11 Medical Treatment

Medical Treatment is treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

1.2.12 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.13 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.14 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.15 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the requirements of [EM 385-1-1](#) Appendix Q, and [ASSE/SAFE Z359.0](#), with a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.16 Recordable Injuries or Illnesses

Recordable Injuries or Illnesses are any work-related injury or illness that results in:

- a. Death, regardless of the time between the injury and death, or the length of the illness;

- b. Days away from work (any time lost after day of injury/illness onset);
- c. Restricted work;
- d. Transfer to another job;
- e. Medical treatment beyond first aid;
- f. Loss of consciousness; or
- g. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (a) through (f) above.

1.2.17 USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.18 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over). Document any mishap that meets the criteria described in the Contractor Significant Incident Report (CSIR) using the Crane High Hazard working group mishap reporting form.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, RO

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G, RO

LHE Inspection Reports

SD-07 Certificates

Crane Operators/Riggers

Standard Lift Plan; G, RO

Critical Lift Plan ; G, RO

Activity Hazard Analysis (AHA)

Hot Work Permit

Certificate of Compliance

License Certificates

1.4 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Provide an SSHO that meets the requirements of EM 385-1-1 Section 1. The SSHO must ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Alternate SSHO must be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO and Alternate SSHO must have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs.

If the SSHO is off-site for a period longer than 24 hours, an equally-qualified alternate SSHO must be provided and must fulfill the same roles and responsibilities as the primary SSHO. When the SSHO is temporarily (up to 24 hours) off-site, a Designated Representative (DR), as identified in the AHA may be used in lieu of an Alternate SSHO, and must be on the project site at all times when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full time occupation.

1.6.1.2 Contractor Quality Control (QC) Manager:

The Contractor Quality Control (QC) person cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties. Also, the Contractor Quality Control (QC) person may not serve as project superintendent for the Contractor.

1.6.1.3 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1, Appendix Q and herein. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for information in consultation with the Safety Office.

1.6.1.3.1 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Section 21.C.04 and herein.

1.6.1.4 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Electrical Standards, Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

- a. Prepare class presentations that cover construction-related safety requirements.
- b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five (5) years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.
- c. Update training course materials whenever an update of the EM 385-1-1 becomes available.
- d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.
- e. Request, review and incorporate student feedback into a continuous course improvement program.

1.6.1.5 Crane Operators/Riggers

Provide Operators meeting the requirements in EM 385-1-1, Section 15.B for Riggers and Section 16.B for Crane Operators. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, designate crane operators qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

1.6.2 Personnel Duties

1.6.2.1 Duties of the Site Safety and Health Officer (SSHO)

The SSHO must:

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.
- b. Conduct mishap investigations and complete required accident reports. Report mishaps and near misses.
- c. Use and maintain OSHA's Form 300 to log work-related injuries and illnesses occurring on the project site for Prime Contractors and subcontractors, and make available to the Contracting Officer upon request. Post and maintain the Form 300A on the site Safety Bulletin Board.
- d. Maintain applicable safety reference material on the job site.
- e. Attend the pre-construction conference, pre-work meetings including preparatory meetings, and periodic in-progress meetings.
- f. Review the APP and AHAs for compliance with EM 385-1-1, and approve, sign, implement and enforce them.
- g. Establish a Safety and Occupational Health (SOH) Deficiency Tracking System that lists and monitors outstanding deficiencies until resolution.
- h. Ensure subcontractor compliance with safety and health requirements.
- i. Maintain a list of hazardous chemicals on site and their material Safety Data Sheets (SDS).
- j. Maintain a weekly list of high hazard activities involving energy, equipment, excavation, entry into confined space, and elevation, and be prepared to discuss details during QC Meetings.
- k. Provide and keep a record of site safety orientation and indoctrination for Contractor employees, subcontractor employees, and site visitors.

Superintendent, QC Manager, and SSHO are subject to dismissal if the above duties are not being effectively carried out. If Superintendent, QC

Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction conference. This includes the project superintendent, Site Safety and Occupational Health officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHAs to preclude project delays.

c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin work until an APP is established that is acceptable to the Contracting Officer.

1.6.3.2 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance. A copy of a suggested weekly safety meeting form is attached at the end of this section.

1.7 ACCIDENT PREVENTION PLAN (APP)

A qualified person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, Appendix A, and as supplemented herein. Cover all paragraph and subparagraph elements in EM 385-1-1, Appendix A. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices

of subcontractors. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed by an officer of the firm (Prime Contractor senior person), the individual preparing the APP, the on-site superintendent, the designated SSHO, the Contractor Quality Control Manager, and any designated Certified Safety Professional (CSP) or Certified Health Physicist (CIH). The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Contracting Officer. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e. imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34), and the environment.

The APP shall consider impacts to pedestrians and high public use areas affected by the work of this contract.

1.7.1 Names and Qualifications

Provide plans in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance.

1.7.2 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.7.2.1 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of 3 months.

1.7.2.2 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.H.01, using Form 16-3. Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Section 16.F.03.

In addition to the requirements of EM 385-1-1, Section 16.H.02, the critical lift plan must include the following:

- a. For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Section 16.T.
- b. Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.7.2.3 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Section 21.D and ASSE/SAFE Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.7.2.4 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ASSE/SAFE Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.7.2.5 Hazardous Energy Control Program (HECP)

Develop a HECP in accordance with EM 385-1-1 Section 12, 29 CFR 1910.147, 29 CFR 1910.333, 29 CFR 1915.89, ASSE/SAFE Z244.1, and ASSE/SAFE A10.44. Submit this HECP as part of the Accident Prevention Plan (APP). Conduct a preparatory meeting and inspection with all effected personnel to coordinate all HECP activities. Document this meeting and inspection in accordance with EM 385-1-1, Section 12.A.02. Ensure that each employee is familiar with and complies with these procedures.

1.7.2.6 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 00 00 EARTHWORK.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1, Section 1 or as directed by the Contracting Officer. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, and fall protection.

1.8.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.8.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must

review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.9 DISPLAY OF SAFETY INFORMATION

1.9.1 Safety Bulletin Board

Within one calendar day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, may be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by [EM 385-1-1](#), Section 01.A.07. Additional items required to be posted include: [Hot work permit](#)

1.9.2 Safety and Occupational Health (SOH) Deficiency Tracking System

Establish a SOH deficiency tracking system that lists and monitors the status of SOH deficiencies in chronological order. Use the tracking system to evaluate the effectiveness of the APP. A monthly evaluation of the data must be discussed in the QC or SOH meeting with everyone on the project. The list must be posted on the project bulletin board and updated daily, and provide the following information:

- a. Date deficiency identified;
- b. Description of deficiency;
- c. Name of person responsible for correcting deficiency;
- d. Projected resolution date;
- e. Date actually resolved.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.12 [NOTIFICATIONS and REPORTS](#)

1.12.1 Mishap Notification

Notify the Contracting Officer as soon as practical, but no more than four hours, after any mishaps, including recordable accidents, incidents, and near misses, as defined in [EM 385-1-1](#) Appendix Q, any report of injury, illness, load handling equipment (LHE) or rigging mishaps, or any property damage. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and

regulatory agencies. Immediate reporting is required for electrical mishaps, to include Arc Flash; shock; uncontrolled release of hazardous energy (includes electrical and non-electrical); load handling equipment or rigging; fall from height (any level other than same surface); and underwater diving. These mishaps must be investigated in depth to identify all causes and to recommend hazard control measures.

Within notification include Contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.12.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

b. Conduct an accident investigation for any load handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident. Complete the Accident Report form and provide the report to the Contracting Officer within TEN calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the Contracting Officer.

1.12.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.12.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a FORM 16-1 Certificate of Compliance for LHE entering an activity under this contract and in accordance with EM 385-1-1. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with EM 385-1-1, Section 16.H.03 using Form 16-2 Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the Contracting Officer for approval within 15 calendar days in advance of planned lift.

1.13 HOT WORK

1.13.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e. welding or cutting) or operating other flame-producing/spark producing devices, from the local Fire Department. A permit is required from the Explosives Safety Office for work in and around where explosives are

processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two 20 pound 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of one hour after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency local fire department phone number. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE LOCAL FIRE DEPARTMENT IMMEDIATELY.

1.14 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

- a. Secure outside equipment and materials and place materials that could be damaged in protected areas.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

- a. Hard Hat
- b. Long Pants
- c. Appropriate Safety Shoes
- d. Appropriate Class Reflective Vests

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily

within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. An employee check-in/check-out communication procedure must be developed to ensure employee safety.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.3 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4, "Changes" and FAR 52.236-2, "Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 14 days in advance. As a minimum, the request must include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with EM 385-1-1 Section 12, 29 CFR 1910.333, 29 CFR 1915.89, and paragraph HAZARDOUS ENERGY CONTROL PROGRAM (HECP).

3.4 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection,

storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Protection Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with EM 385-1-1, Section 21.C. Document training and practical application of the competent person in accordance with EM 385-1-1, Section 21.C.04 and ASSE/SAFE Z359.2 in the AHA.

3.4.2 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Section 21.I, 29 CFR 1926.500 Subpart M, ASSE/SAFE Z359.0, ASSE/SAFE Z359.1, ASSE/SAFE Z359.2, ASSE/SAFE Z359.3, ASSE/SAFE Z359.4, ASSE/SAFE Z359.6, ASSE/SAFE Z359.7, ASSE/SAFE Z359.11, ASSE/SAFE Z359.12, ASSE/SAFE Z359.13, ASSE/SAFE Z359.14, and ASSE/SAFE Z359.15.

3.4.2.1 Additional Personal Fall Protection

In addition to the required fall protection systems, other protection such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water in accordance with EM 385-1-1, Sections 21.0 through 21.0.06. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.4.2.2 Personal Fall Protection Harnesses

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabiners must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. All full body harnesses must be equipped with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with

EM 385-1-1, Section 21.I.06.

3.4.3 Horizontal Lifelines (HLL)

Provide HLL in accordance with EM 385-1-1, Section 21.I.08.d.2. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a qualified person, for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500). The competent person for fall protection may (if deemed appropriate by the qualified person) supervise the assembly, disassembly, use and inspection of the HLL system under the direction of the qualified person. Locally manufactured HLLs are not acceptable unless they are custom designed for limited or site specific applications by a Registered Professional Engineer who is qualified in designing HLL systems.

3.4.4 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Section 21.F.01 and 29 CFR 1926 Subpart M.

3.4.5 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must comply with the requirements of EM 385-1-1, ASSE/SAFE Z359.2, and ASSE/SAFE Z359.4.

3.5 WORK PLATFORMS

3.5.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

- a. Scaffold platforms greater than 20 feet in height must be accessed by use of a scaffold stair system.
- b. Ladders commonly provided by scaffold system manufacturers are prohibited for accessing scaffold platforms greater than 20 feet maximum in height.
- c. An adequate gate is required.
- d. Employees performing scaffold erection and dismantling must be qualified.
- e. Scaffold must be capable of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan.

- f. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.
- g. Special care must be given to ensure scaffold systems are not overloaded.
- h. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in must be at the height equal to 4 times the width of the smallest dimension of the scaffold base.
- i. Scaffolding other than suspended types must bear on base plates upon wood mudsills (2 in x 10 in x 8 in minimum) or other adequate firm foundation.
- j. Scaffold or work platform erectors must have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 feet.
- k. Delineate fall protection requirements when working above 6 feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.5.2 Elevated Aerial Work Platforms (AWPs)

Workers must be anchored to the basket or bucket in accordance with manufacturer's specifications and instructions (anchoring to the boom may only be used when allowed by the manufacturer and permitted by the CP). Lanyards used must be sufficiently short to prohibit worker from climbing out of basket. The climbing of rails is prohibited. Lanyards with built-in shock absorbers are acceptable. Self-retracting devices are not acceptable. Tying off to an adjacent pole or structure is not permitted unless a safe device for 100 percent tie-off is used for the transfer.

Use of AWPs must be operated, inspected, and maintained as specified in the operating manual for the equipment and delineated in the AHA. Operators of AWPs must be designated as qualified operators by the Prime Contractor. Maintain proof of qualifications on site for review and include in the AHA.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment (MHE)

- a. Material handling equipment such as forklifts must not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions. Material handling equipment fitted with personnel work platform attachments are prohibited from traveling or positioning while personnel are working on the platform.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Material Handling Equipment Operators must be trained in accordance with OSHA 29 CFR 1910, Subpart N.
- c. Operators of forklifts or power industrial trucks must be licensed in accordance with OSHA.

3.6.2 Load Handling Equipment (LHE)

- a. Equip cranes and derricks as specified in EM 385-1-1, Section 16.
- b. Notify the Contracting Officer 15 working days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Section 16.A.02, so that necessary quality assurance spot checks can be coordinated. Contractor's operator must remain with the crane during the spot check. Rigging gear must comply with OSHA and ASME B30.9.
- c. Comply with the LHE manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.
- d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.
- e. Under no circumstance must a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.
- f. When operating in the vicinity of overhead transmission lines, operators and riggers must be alert to this special hazard and follow the requirements of EM 385-1-1 Section 11, and ASME B30.5 or ASME B30.22 as applicable.
- g. Do not use crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane. Additionally, submit a specific AHA for this work to the Contracting Officer. Ensure the activity and AHA are thoroughly reviewed by all involved personnel.
- h. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.
- i. All employees must keep clear of loads about to be lifted and of suspended loads.
- j. Use cribbing when performing lifts on outriggers.
- k. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
- l. A physical barricade must be positioned to prevent personnel access where accessible areas of the LHE's rotating superstructure poses a risk of striking, pinching or crushing personnel.
- m. Maintain inspection records in accordance by EM 385-1-1, Section 16.D, including shift, monthly, and annual inspections, the signature of the person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Contracting Officer.
- n. Maintain written reports of operational and load testing in accordance

with EM 385-1-1, Section 16.F, listing the load test procedures used along with any repairs or alterations performed on the LHE. Reports must be available for review by the Contracting Officer.

o. Certify that all LHE operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

p. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 20 mph, the operator, rigger and lift supervisor must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base the determination to proceed or not on wind calculations per the manufacturer and a reduction in LHE rated capacity if applicable. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.

3.6.3 Machinery and Mechanized Equipment

a. Proof of qualifications for operator must be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment must be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

3.6.4 USE OF EXPLOSIVES

Explosives must not be used.

3.7 EXCAVATIONS

3.7.1 Utility Locations

Provide a third party, independent, private utility locating company to positively identify underground utilities in the work area in addition to any station locating service and coordinated with the station utility department. Dig Safe will not have information concerning underground utilities in park land. The Contractor shall note that there are Fire Department lines within the work area with specialized connections.

3.7.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within 3 feet of the underground system.

3.7.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company must locate utility depth by use of

Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the Contractor from meeting this requirement.

3.8 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Appendix A, Sections 11 and 12.

3.8.1 Conduct of Electrical Work

As delineated in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the Contracting Officer. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

3.8.2 Qualifications

Electrical work must be performed by QP personnel with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, and local requirements applicable to where work is being performed.

3.8.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and

circuit parts. Training must be administered by an electrically qualified source and documented.

3.8.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with [NFPA 70](#) and [IEEE C2](#) to provide a permanent, continuous and effective path to ground unless otherwise noted by [EM 385-1-1](#).

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.8.5 Testing

Temporary electrical distribution systems and devices must be inspected,

tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

August 02, 2018

WEEKLY SAFETY MEETING

CENAE

Date Held _____
Time _____

SUBJECT: CONTRACT NO. _____ - WEEKLY SAFETY MEETING

CONTRACTOR _____

PERSONNEL PRESENT

| Contr. | Sub. | Govt. |

Date and Time Held: _____

Conducted By: _____

| | | |
| | | |

All persons attending the meeting must sign the bottom or back of this form.

Subjects discussed (Note, delete, or add):

EM 385-1-1, Section: _____

Accident Prevention Plan _____ Individual Protective Equipment _____

Prevention of Falls _____ Back Injury/Safe Lifting Techniques _____

Fire Prevention _____ Sanitation, First Aid, Waste Disposal _____

Tripping Hazards _____ Clean-up - trash, nails in lumber _____

Staging, Ladders, Concrete Forms, Safety Nets _____

Hand Tools, Power Tools, Machinery, Chain Saws _____

Equipment Inspection & Maintenance (Zero Defects) _____

Hoisting Equipment, Winch and Crane Safety _____

Ropes, Hooks, Chains and Slings _____

Vehicle Operation Safety _____

Electrical Grounding, Temporary Wiring, GFCI _____

Lockouts/Safe clearance procedures
(electrical, pressure, moving parts) _____

Welding, Cutting _____ Excavation Hazard/Rescue _____

Loose Rock/Steep Slopes _____ Explosives _____

Water Safety _____ Boat Safety _____

HAZMAT, Toxic hazards, MSDS, respiratory, ventilation _____

Other Items of concern specific to this contract:

CQC Rep. Signature _____ CE Inspector _____

CF:

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SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AACE INTERNATIONAL (AACE)
1265 Suncrest Towne Centre Drive
Morgantown, WV 26505-1876 USA
Ph: 304-296-8444
Fax: 304-291-5728
E-mail: info@aacei.org
Internet: <http://www.aacei.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aaashto.org
Internet: <http://www.aashto.org>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: <http://www.americanbearings.org>

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: <http://www.concrete.org>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
8445 Freeport Parkway, Suite 350
Irving, TX 75063-2595
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: <http://www.concrete-pipe.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1899 L Street, NW, 11th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: storemanager@ansi.org
Internet: <http://www.ansi.org/>

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
1800 East Oakton Street
Des Plaines, IL 60018
Ph: 847-699-2929
Internet: <http://www.asse.org>

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy Avenue
Denver, CO 80235-3098
Ph: 303-794-7711
E-mail: distribution@awwa.org
Internet: <http://www.awwa.org>

AMERICAN WELDING SOCIETY (AWS)
13301 NW 47 Ave
Miami, FL 33054

Ph: 888-WELDING, 305-824-1177, 305-826-6192
Fax: 305-826-6195
E-mail: customer.service@awspubs.com
Internet: <http://www.aws.org>

ASME INTERNATIONAL (ASME)
Two Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: <http://www.asme.org>

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 877-909-2786
Internet: <http://www.astm.org>

CSA GROUP (CSA)
178 Rexdale Blvd.
Toronto, ON, Canada M9W 1R3
Ph: 416-747-4044
Fax: 416-747-2510
E-mail: sales@csagroup.org

Internet: <http://www.csagroup.org/us/en/home>

FM GLOBAL (FM)
270 Central Avenue
P.O. Box 7500
Johnston, RI 02919-4923
Ph: 877-364-6726
Fax: 401-275-3029
E-mail: servicedesk.myrisk@fmglobal.com
Internet: <http://www.fmglobal.com>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-9667
E-mail: onlinesupport@ieee.org
Internet: <http://www.ieee.org>

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
E-mail:
http://www.icea.net/Public_Pages/Contact/Email_Contact.html
Internet: <http://www.icea.net>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: <http://www.nema.org/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
Internet: <http://www.nfpa.org>

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)
1320 City Center Drive, Suite 200
Carmel, IN 46032
Ph: 317-571-9500 or 800 366 7731
Fax: 317-571-0041
Internet: www.precast.org

U.S. ARMY (DA)
U.S. Army Publishing Directorate
Ph: 703-614-3634
Internet: <http://www.apd.army.mil>

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ccb/browse_cat.php?c=68
Order Other Documents from:
USACE Publications Depot
Attn: CEHEC-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102

Ph: 301-394-0081
Fax: 301-394-0084
E-mail: pubs-army@usace.army.mil
Internet: <http://www.publications.usace.army.mil/>
or
<http://www.hnc.usace.army.mil/Missions/Engineering/TECHINFO.aspx>

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8871
Fax: 704-852-4189
E-mail: seed.ams@usda.gov
Internet: <http://www.ams.usda.gov/lsg/seed.htm>
Order Other Publications from:
U.S. Department of Agriculture, Rural Utilities Program
USDA Rural Development, Room 4051-S
Mail Stop 1510
1400 Independence Avenue SW
Washington, DC 20250-1510
Phone: (202) 720-9540
TTY: (800) 877-8339 (Federal Relay Service)
Fax: (202) 720-1725
Internet: http://www.rurdev.usda.gov/utilities_lp.html

U.S. DEPARTMENT OF ENERGY (DOE)
1000 Independence Avenue Southwest
Washington, D.C. 20585
Internet: www.eere.energy.gov

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-272-0167
Internet: <http://www2.epa.gov/libraries>
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6050 or 1-688-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: <http://www.ntis.gov>

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1275 First St. NE
Washington, DC 20417
Ph: 202-501-1231
Internet: <http://www.gsaelibrary.gsa.gov/ElibMain/home.do>
Obtain documents from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Internet: <https://assist.dla.mil/online/start/>; account
registration required

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
Internet: <http://www.archives.gov>
Order documents from:
Superintendent of Documents
U.S. Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577
E-mail: CEC.us@us.ul.com
Internet: <http://www.ul.com/>
UL Directories available through IHS at <http://www.ihs.com>

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

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SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D3740 (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E329 (2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Bid Schedule item.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Quality Control (CQC) Plan; G, RO

SD-06 Test Reports

Verification Statement

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system that

complies with the Contract Clause titled "Inspection of Construction." QC consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The QC system must cover all construction operations, both onsite and offsite, and be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent must maintain a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

3.2 QUALITY CONTROL PLAN

Submit no later than 15 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The Government will consider an interim plan for the first 14 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work.

3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager who reports to the project superintendent.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.
- c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager.
- d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures must be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.
- e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and

person responsible for each test. (Laboratory facilities approved by the Contracting Officer must be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer and discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 14 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and the Contracting Officer and will become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager, and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager must report directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff must maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a construction person with a minimum of five years in related work. This CQC System Manager must be on the site at all times during construction, shall be employed by the prime Contractor, and must be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

Provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: civil and environmental. These individuals must be directly employed by the prime Contractor and may not be employed by a supplier or subcontractor on this project; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. A single person may cover more than one area provided that they are qualified to perform QC activities in each designated and that workload allows.

Experience Matrix

Area	Qualifications
Civil	Graduate Civil Engineer or Construction Manager with

Experience Matrix

Area	Qualifications
	10 years experience in the type of work being performed on this project
Environmental	Graduate Environmental Engineer with 5 yrs experience

3.4.4 Additional Requirement

In addition to the above experience and education requirements, the CQC System Manager must have completed the Construction Quality Management (CQM) for Contractors course. If the CQC System Manager does not have a current certification, obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered at the U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, MA. Contact the Contracting Officer for information on the next scheduled class.

The Construction Quality Management Training certificate expires after 5 years. If the CQC System Manager's certificate has expired, retake the course to remain current.

3.4.5 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, must comply with the requirements in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control must be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

- b. Review of the contract drawings.
- c. Check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. Review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Discussion of the initial control phase.
- k. The Government must be notified at least 24 hours in advance of beginning the preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

- a. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing are in compliance with the contract.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with

each worker.

f. The Government must be notified at least 24 hours in advance of beginning the initial phase for definable feature of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases.

g. The initial phase for definable feature of work should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. Procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual

test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

The listing of validated testing laboratories is available at <http://gsl.erdc.usace.army.mil/SL/MTC/>.

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel must meet criteria detailed in [ASTM D3740](#) and [ASTM E329](#).

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Charges will be based on the price schedule located at <http://www.wes.army.mil/SL/MTC/mtc.htm>. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers, 696 Virginia Road, Concord, Massachusetts 01742-2751. Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC System Manager near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been

corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph must be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative must be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notify the Contracting Officer at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings

requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's [Verification Statement](#).

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days must be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports must be signed and dated by the CQC System Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manager Report.

3.10 SAMPLE FORMS

A sample blank "Daily Construction Quality Control Report" generated from the USACE Quality Control System (QCS) software package is attached at the end of this section. This form should be completed daily in QCS as required by Section [01 45 01](#) RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM) of these specifications.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

CONTRACTORS QUALITY CONTROL REPORT (QCR) DAILY LOG OF CONSTRUCTION - CIVIL		REPORT NUMBER _____ Page 1 of 1 DATE _____																					
PROJECT _____		CONTRACT NUMBER _____																					
CONTRACTOR _____	WEATHER _____																						
QC NARRATIVES WORK PERFORMED TODAY																							
PREP/INITIAL DATES (Preparatory and initial dates held and advance notice)																							
ACTIVITY START/FINISH																							
QC REQUIREMENTS																							
QA/QC PUNCH LIST (Describe QC Punch List items issued, Report QC and QA Punch List items corrected)																							
CONTRACTORS ON SITE (Report first and/or last day contractors were on site) No contractors had their first or last day on site today																							
LABOR HOURS The following labor hours were Reported today: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">Employer _____</th> <th style="text-align: left;">Labor Classification _____</th> <th style="text-align: left;">Number of Employees _____</th> <th style="text-align: left;">Hours Worked _____</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="2" style="text-align: right;">Total hours worked to date:</td> <td style="text-align: right;">Total</td> <td>_____</td> </tr> </tbody> </table>				Employer _____	Labor Classification _____	Number of Employees _____	Hours Worked _____													Total hours worked to date:		Total	_____
Employer _____	Labor Classification _____	Number of Employees _____	Hours Worked _____																				
Total hours worked to date:		Total	_____																				
EQUIPMENT HOURS The following equipment hours were Reported today: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">Serial Number _____</th> <th style="text-align: left;">Description _____</th> <th style="text-align: left;">Standby Hours _____</th> <th style="text-align: left;">Operating Hours _____</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="2" style="text-align: right;">Total operating hours to date:</td> <td style="text-align: right;">Total</td> <td>_____</td> </tr> </tbody> </table>				Serial Number _____	Description _____	Standby Hours _____	Operating Hours _____													Total operating hours to date:		Total	_____
Serial Number _____	Description _____	Standby Hours _____	Operating Hours _____																				
Total operating hours to date:		Total	_____																				
ACCIDENT REPORTING (Describe accidents) No accidents reported today																							
CONTRACTOR CERTIFICATION On behalf of the contractor, I certify that this Report is complete and correct and all equipment and material used and work performed during this Reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.																							
QC REPRESENTATIVE'S SIGNATURE _____	DATE _____	SUPERINTENDENT'S INITIALS _____	DATE _____																				

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SECTION 01 45 01

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements
Manual

1.2 Contract Administration

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Contractor uses the Government-furnished Construction Contractor Mode of RMS, referred to as RMS CS, to record, maintain, and submit various information throughout the contract period. The Contractor mode user manuals, updates, and training information can be downloaded from the [RMS](http://rms.usace.army.mil) web site (<http://rms.usace.army.mil>). The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data

1.2.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible between the Government and Contractor. Correspondence, pay requests and other documents comprising the official contract record are also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.2.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01 PROJECT SCHEDULE, Section 01 33 00 SUBMITTAL PROCEDURES, and Section 01 45 00 QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through RMS. Also, there is no separate payment for establishing and maintaining the RMS database; costs associated will be

included in the contract pricing for the work.

1.3 RMS SOFTWARE

RMS is a Windows-based program that can be run on a Windows based PC meeting the requirements as specified in Section 1.3. The Government will make available the RMS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor will be responsible to download, install and use the latest version of the RMS software from the Government's RMS Internet Website. Any program updates of RMS will be made available to the Contractor via the Government RMS Website as the updates become available.

1.3.1 RMS CONTRACTOR'S MODE (CM)

RMS Contractor's Mode or RMS CM is the replacement for Quality Control System or QCS. The database remains the same. References to RMS in this specification includes RMS CM.

1.4 SYSTEM REQUIREMENTS

The following is the minimum system configuration required to run RMS and Contractor Mode:

Minimum RMS System Requirements	
Hardware	
Windows-based PC	1.5 GHz 2 core or higher processor
RAM	8 GB
Hard drive disk	200 GB space for sole use by the QCS system
Monitor	Screen resolution 1366 x 768
Mouse or other pointing device	
Windows compatible printer	Laser printer must have 4 MB+ of RAM
Connection to the Internet	minimum 4 Mbs per user
Software	
MS Windows	Windows 7 x 64 bit (RMS requires 64 bit O/S) or newer
Word Processing software	Viewer for MS Word 2013, MS Excel 2013, or newer

Minimum RMS System Requirements	
Microsoft.NET Framework	Coordinate with Government QA Representative for free version required
Email	MAPI compatible
Virus protection software	Regularly upgraded with all issued manufacturer's updates and is able to detect most zero day viruses.

1.5 RELATED INFORMATION

1.5.1 RMS User Guide

After contract award, download instructions for the installation and use of RMS from the Government RMS Internet Website.

1.6 CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for RMS. The Government will provide data updates to the Contractor as needed. These updates will generally consist of submittal reviews, correspondence status, Quality Assurance(QA) comments, and other administrative and QA data.

1.7 DATABASE MAINTENANCE

Establish, maintain, and update data in the RMS database throughout the duration of the contract at the Contractor's site office. Submit data updates to the Government (e.g., daily reports, submittals, RFI's, schedule updates, payment requests) using RMS. The RMS database typically includes current data on the following items:

1.7.1 Administration

1.7.1.1 Contractor Information

Contain within the database the Contractor's name, address, telephone numbers, management staff, and other required items. Within 7 calendar days of receipt of RMS software from the Government, deliver Contractor administrative data in electronic format in RMS.

1.7.1.2 Subcontractor Information

Contain within the database the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed. Assign each subcontractor/trade a unique Responsibility Code, provided in RMS. Within 7 calendar days of receipt of RMS software from the Government, deliver subcontractor administrative data in electronic format.

1.7.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.7.1.4 Equipment

Contain within the Contractor's RMS database a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5 Management Reporting

RMS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of RMS. Among these reports are: Progress Payment Request worksheet, Quality Assurance/Quality Control (QA/QC) comments, Submittal Register Status, Three-Phase Control checklists.

1.7.1.6 Request For Information (RFI)

Exchange all Requests For Information (RFI) using the Built-in RFI generator and tracker in RMS. The Government has up to 14 calendar days to respond to routine RFIs and up to 21 calendar days for more complex RFI's.

1.7.2 Finances

1.7.2.1 Pay Activity Data

Include within the RMS database a list of pay activities that the Contractor develops in conjunction with the construction schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities equals the amount of each CLIN. The sum of all CLINs equals the contract amount.

1.7.2.2 Payment Requests

Prepare all progress payment requests using RMS. Complete the payment request worksheet, prompt payment certification, and payment invoice in RMS. Update the work completed under the contract, measured as percent or as specific quantities, at least monthly. After the update, generate a payment request report using RMS. Submit the payment request, prompt payment certification, and payment invoice with supporting data using RMS CM. If permitted by the Contracting Officer, email or a optical disc may be used. A signed paper copy of the approved payment request is also required and will govern in the event of discrepancy with the electronic version.

1.7.3 Quality Control (QC)

RMS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements. Maintain

this data on a daily basis. Entered data will automatically output to the RMS generated daily report. Provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 00 QUALITY CONTROL. Within seven calendar days of Government acceptance, submit a RMS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.7.3.1 Daily Contractor Quality Control (CQC) Reports.

RMS includes the means to produce the Daily CQC Report. The Contractor can use other formats to record basic Quality Control (QC) data. However, the Daily CQC Report generated by RMS must be the Contractor's official report. Summarize data from any supplemental reports by the Contractor and consolidate onto the RMS-generated Daily CQC Report. Submit daily CQC Reports as required by Section 01 45 00 QUALITY CONTROL. Electronically submit reports to the Government within 24 hours after the date covered by the report. Also provide the Government a signed, printed copy of the daily CQC report.

1.7.3.2 Deficiency Tracking.

Use RMS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using its Quality Control (QC) punch list items. Maintain a current log of its QC punch list items in the RMS database. The Government will log the deficiencies it has identified using its Quality Assurance (QA) punch list items. The Government's QA punch list items will be included in its export file to the Contractor. Regularly update the correction status of both QC and QA punch list items.

1.7.3.3 QC Requirements

Develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in RMS. Update data on these QC requirements as work progresses, and promptly provide the information to the Government via RMS.

1.7.3.4 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS.

1.7.3.5 Labor and Equipment Hours

Log labor and equipment exposure hours on a daily basis. The labor and equipment exposure data will be rolled up into a monthly exposure report.

1.7.3.6 Accident/Safety Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be provided via RMS CM. Regularly update the correction status of the safety comments. In addition, utilize RMS to advise the Government of any accidents occurring on the jobsite. A brief supplemental entry of an accident is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 300.

1.7.3.7 Features of Work

Include a complete list of the features of work in the RMS database. A feature of work is associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.7.3.8 Hazard Analysis

Use RMS CM to develop a hazard analysis for each feature of work included in the CQC Plan. The Activity Hazard Analysis will include information required by [EM 385-1-1](#), paragraph 01.A.13.

1.7.4 Submittal Management

The Government will provide the initial submittal register in electronic format. Thereafter, maintain a complete list of submittals, including completion of data columns. Dates when submittals are received and returned by the Government will be included. Use RMS CM to track and transmit submittals. ENG Form 4025, submittal transmittal form, and the submittal register update is produced using RMS. RMS will be used to update, store and exchange submittal registers and transmittals. In addition to requirements stated in specification 01 33 00, actual submittals are to be stored in RMS CM, with hard copies also provided. Exception will be where the Contracting Officer specifies only hard copies required, where size of document cannot be saved in RMS CM, and where samples, spare parts, color boards, and full size drawings are to be provided.

1.7.5 Schedule

Develop a construction schedule consisting of pay activities, in accordance with Section [01 32 01](#) PROJECT SCHEDULE. Input and maintain in the RMS database the schedule either manually or by using the Standard Data Exchange Format (SDEF) (see Section [01 32 01](#) PROJECT SCHEDULE). Include with each pay request the updated schedule. Provide electronic copies of transmittals.

1.7.6 Import/Export of Data

RMS includes the ability to import schedule data using SDEF.

1.8 IMPLEMENTATION

Use of RMS CM as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS CM system. RMS CM is an integral part of the Contractor's management of quality control.

1.9 MONTHLY COORDINATION MEETING

Update the RMS CM database each workday. At least monthly, generate and submit a schedule update. At least one week prior to submittal, meet with the Government representative to review the planned progress payment data submission for errors and omissions.

Make required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will not be accepted. The Government will not

process progress payments until all required corrections are processed.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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 - 1.10.1 Administrative Field Offices
 - 1.10.2 Staging Areas
 - 1.10.3 Appearance of Trailers
 - 1.10.4 Maintenance of Staging Areas
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 - 1.10.5 Security Provisions
 - 1.10.6 Storage of Hazardous Materials
 - 1.10.7 Usage of Fuels and Lubricants
- 1.11 GOVERNMENT FIELD OFFICE
 - 1.11.1 Resident Engineer's Office
 - 1.11.2 Trailer-Type Mobile Office
- 1.12 PLANT COMMUNICATION
- 1.13 CONSTRUCTION SITE LIGHTING
- 1.14 CLEANUP
- 1.15 RESTORATION OF STORAGE AREA

-- End of Section Table of Contents --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2013; Errata 2015) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70 (2017) National Electrical Code

NFPA 70E (2015; ERTA 1 2015) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Site Plan; G, RO

The Contractor shall submit the site plan as specified in Subpart SITE PLAN.

1.3 SITE PLAN

The Contractor shall prepare a site plan indicating the proposed location and dimensions of all temporary construction enclosures and gates around areas to be used by the Contractor (e.g., assigned staging areas), locations of ingress/egress to the enclosed areas, and details of enclosure construction. Ingress/egress areas to be graveled to prevent the tracking of dirt and mud onto public ways shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is proposed. Deviations from the approved Site Plan shall be coordinated with the Contracting Officer, and approved, prior to implementation.

1.4 CONSTRUCTION AND EMPLOYEE PARKING

The Contractor shall control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Government inspectors operations, or construction operations. Contractor employees may park privately owned vehicles in designated areas within fenced work areas that are not under the tree canopy. On-street Contractor employee parking in the vicinity of the work sites is prohibited. Parking of Contractor employee vehicles in the park and outside designated areas is prohibited.

1.5 AVAILABILITY OF WATER AND ELECTRICITY

All water and electricity that may be required in the prosecution of the work shall be furnished by the Contractor at his own expense. There will be no Government furnished water and electricity at the work sites.

1.5.1 Temporary Electrical Equipment and Connections

a. Provide a temporary electrical distribution system for temporary power and lighting, to include equipment and connections, in accordance with **EM 385-1-1**, **NFPA 70**, and **NFPA 70E**. The Contractor, or his delegated subcontractor, shall enforce all the safety requirements of electrical extensions for the work of all subcontractors. All work shall be accomplished by skilled electrical tradesmen in a workmanlike manner, as approved by the Contracting Officer.

b. Temporary lighting circuits shall be separate from electrical tool circuits. Receptacle circuits shall be dedicated to either temporary lighting or electric tools and shall be labeled "LIGHTS ONLY" or "TOOLS ONLY," as acceptable.

c. A sketch of the proposed temporary electrical system shall be submitted and accepted by the Contracting Officer before temporary power and lighting is installed. The sketch shall indicate the location, voltages, and means of protection of all circuits, including receptacles, disconnecting means, grounding, GFCIs, and lighting circuits.

1.5.1.1 Temporary Wiring

Provide temporary wiring in accordance with **NFPA 241** and **NFPA 70**, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

1.5.1.2 Construction Equipment

In addition to the requirements of **EM 385-1-1**, all temporary wiring conductors installed for operation of construction tools and equipment shall be either Type TW or THW contained in metal raceways, or may be multiconductor cord. Temporary wiring shall be secured above the ground or floor in a workmanlike manner and shall not present an obstacle to persons or equipment. Open wiring may only be used outside of buildings, and then only in strict accordance with the provisions of the National Electrical Code.

1.5.1.3 Circuit Protection

In addition to the requirements in **EM 385-1-1** and **NFPA 70**, all 15 and 20-ampere receptacle outlets used for obtaining power during construction

shall have ground fault circuit interrupters (GFCI) for personnel protection. All generator-powered 15- and 20-ampere, 60 Hertz receptacle outlets shall have GFCI'S, and shall be properly grounded. A testing means shall be provided which will impose a measured fault of 5 milliamperes, plus or minus 1 milliamperes, and result in tripping the GFCI unit.

1.6 SANITATION FACILITIES

1.6.1 Work Sites

In accordance with Section 2 of EM 385-1-1, provide, maintain, and make available to all workers provisions for sanitation. Maintain these provisions at all times without nuisance. Upon completion of the work, all sanitary provisions and facilities shall be removed from the premises by the Contractor, leaving the premises clean and free from nuisance.

In accordance with Section 2, Subpart 02.C of EM 385-1-1, provide, maintain, and make available to all workers an adequate supply of potable water for both drinking and personal cleansing. During hot weather, provide cool drinking water.

In accordance with Section 2, Subpart 02.E of EM 385-1-1, provide, maintain, and make available to all workers adequate minimum field-type portable toilets. Portable toilets shall be properly secluded from public observation in such a manner as required or approved by the Contracting Officer. Periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Include provisions for pest control and elimination of odors. Any penalties and/or fines associated with improper discharge of wastewater shall be the responsibility of the Contractor. Government toilet facilities will not be provided.

Temporary sanitation facilities shall not be attached to trees. Sanitary facilities shall be removed if high water is anticipated.

1.7 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.7.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located outside the Contractor's field office in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.7.2 Project and Safety Signs

The requirements for the signs and their content shall be as shown on the drawings attached to this section. The signs shall be erected at the location indicated by the Contracting Officer within 15 days after receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site and the site shall be restored.

1.7.3 Notofication Signs on Construction Fence

Signs, approaimately 1 foot by 1 foot, shall be mounted on the construction fence and securly fastened at entrances to the work areas and also approximately every 300 feet showing contact information for the General Contractor.

1.8 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access as necessary to maintain vehicular, bicycle, and pedestrian traffic. The Contractor shall maintain and protect traffic on all affected roads, pathways and sidewalks during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.9 CONSTRUCTION SITES AND STAGING AREAS ENCLOSURES

Prior to beginning any work at the project sites including delivery or storage of any materials or equipment, the Contractor shall furnish and install staging area enclosures to prevent access to active work areas by the public. The Contractor shall install and maintain concrete barriers and/or temporary construction fencing around work and staging areas.

1.9.1 Concrete Barriers

Concrete barriers shall be used wherever enclosures will be used to both prevent unauthorized entry to the staging or work areas and as a traffic control device. Concrete barriers in such areas shall be "jersey-type" concrete barriers with a 6-foot high galvanized chain link fence attached to their top. Concrete barriers shall be connected together and be FHWA approved. Concrete barriers shall have 3-inch minimum length yellow retro reflectors mounted to the top and side of the barriers and spaced 25-feet on center. The retro reflectors shall be mounted at a uniform height of at least 2-feet above the pavement surface. Barriers that encroach into paved areas such as roads or sidewalks shall be clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Barriers shall be clean and in a good state of repair.

1.9.2 Temporary Construction Fencing

Temporary construction fencing shall be used where enclosures around work sites or staging areas will not also be used as a traffic control device. Construction fencing shall be 8-foot galvanized chain link fencing. Construction fencing posts shall be driven into the ground. An effort shall be made to avoid surficial tree roots.

1.9.3 Construction Fence Screening

Construction fencing screening material and chain link fencing screening material shall not be used.

1.9.4 Gates

Gates in concrete barriers or temporary construction fencing shall be chain link fence type gates. Gates shall be installed where shown or, if not shown, shall be located to minimize adverse impacts to existing roadways, pathways, and sidewalks, and other site features. Gates shall have padlocks.

1.10 CONTRACTOR'S TEMPORARY FACILITIES

1.10.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction or storage area as shown on the contract drawings and as directed by the Contracting Officer.

1.10.2 Staging Areas

See Subpart CONSTRUCTION SITES AND STAGING AREAS ENCLOSURES for requirements concerning staging area enclosures. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct staging area by the Contracting Officer away from the vicinity of the construction site. Trailers, equipment, or materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at all times.

1.10.3 Appearance of Trailers

Trailers utilized by the Contractor shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the project site.

1.10.4 Maintenance of Staging Areas

Enclosures shall be kept in a state of good repair and proper alignment. Areas in the vicinity of entrances and exits in staging areas shall be covered with a gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. See the contract drawings for tree root protection requirements.

1.10.4.1 Snow Removal

The Contractor is responsible for snow removal as needed within work areas to facilitate the work. In addition, the Contractor is responsible for snow removal including weekends and holidays to ensure public access on relocated public paths for the duration of the project.

1.10.5 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.10.6 Storage of Hazardous Materials

Hazardous materials shall be stored using a secondary containment system and managed to prevent all impacts to drainage inlets, waterbodies (rivers, streams, lakes), environmentally sensitive areas (wetlands, vernal pools). Storage will be allowed on site only during working hours and shall be elevated above the flood plain.

1.10.7 Usage of Fuels and Lubricants

Refer to Section 01 57 20 ENVIRONMENTAL PROTECTION, subpart "Chemical Materials Management and Waste Disposal", subparagraph "Fuel and Lubricants".

1.11 GOVERNMENT FIELD OFFICE

1.11.1 Resident Engineer's Office

The Contractor shall provide the Government Resident Engineer with a field office. Four dedicated parking spaces for Government use shall be available at the Government Field Office location. This office shall be located in the vicinity of the Contractor's field office structure, as shown on the contract drawings, and as appropriate for the convenience of the Government. The office shall be approximately 400 square feet in floor area (not including hallways, conference rooms, closets, and bathrooms), located where directed and providing space heat, electric light and power, toilet facilities consisting of one lavatory and one water closet complete with connections to water and sewer mains, and weekly cleaning of the office including trash removal. A portable toilet may be substituted for the water closet. This portable toilet will be reserved for use by Government personnel only. One closet with shelving and a clothing rod shall be included. One voice telephone line and a dedicated high speed data internet connection (T1) shall be furnished. A mail slot in the door or a lockable mail box mounted on the surface of the door shall be provided. The office shall be alarmed with door and motion sensors and wired to a central station. Alarms that are audible outside of the temporary office structure are not permitted. All windows shall have security grates. The Contractor shall furnish and install furniture and equipment to include one 5-drawer file cabinet, four 3' x 6' desks, one 3'x 8' conference table with 10 chairs, one 2.5'x 4' book case and 4 wheeled desk chairs. Furniture may be used, but must be clean and in good working order. The Contractor is responsible for snow removal for the dedicated parking spaces and for maintaining access to the trailer. At completion of the project, the office shall remain the property of the Contractor and shall be removed from the site. Utilities shall be connected and disconnected in accordance with local codes and to the satisfaction of the Contracting Officer.

1.11.2 Trailer-Type Mobile Office

The Contractor may, at its option, furnish and maintain a trailer-type

mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds.

1.12 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.13 CONSTRUCTION SITE LIGHTING

Work performed at night shall be properly illuminated to establish safe working conditions.

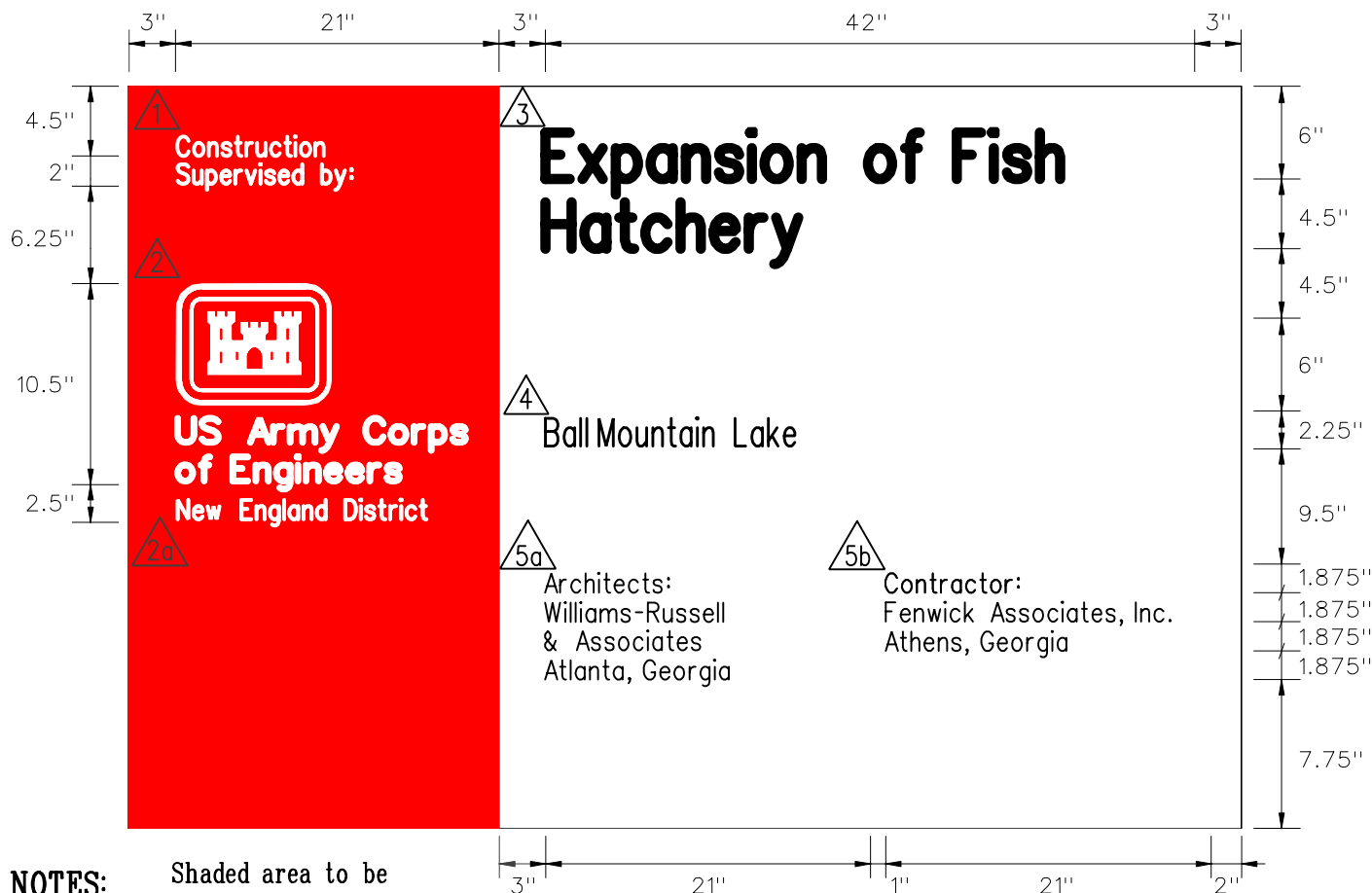
1.14 CLEANUP

Construction debris, waste materials, packaging material, trash, graffiti and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced staging areas. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.15 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the enclosed areas, the enclosures shall be removed and will become the property of the Contractor. Areas disturbed by the Contractor, which are not restored as part of the required work, for the storage of equipment or material, or other use, shall be restored to the original or better condition.

-- End of Section --



**NOTES:
LEGEND
GROUP**

Shaded area to be
Communications Red

DESCRIPTION

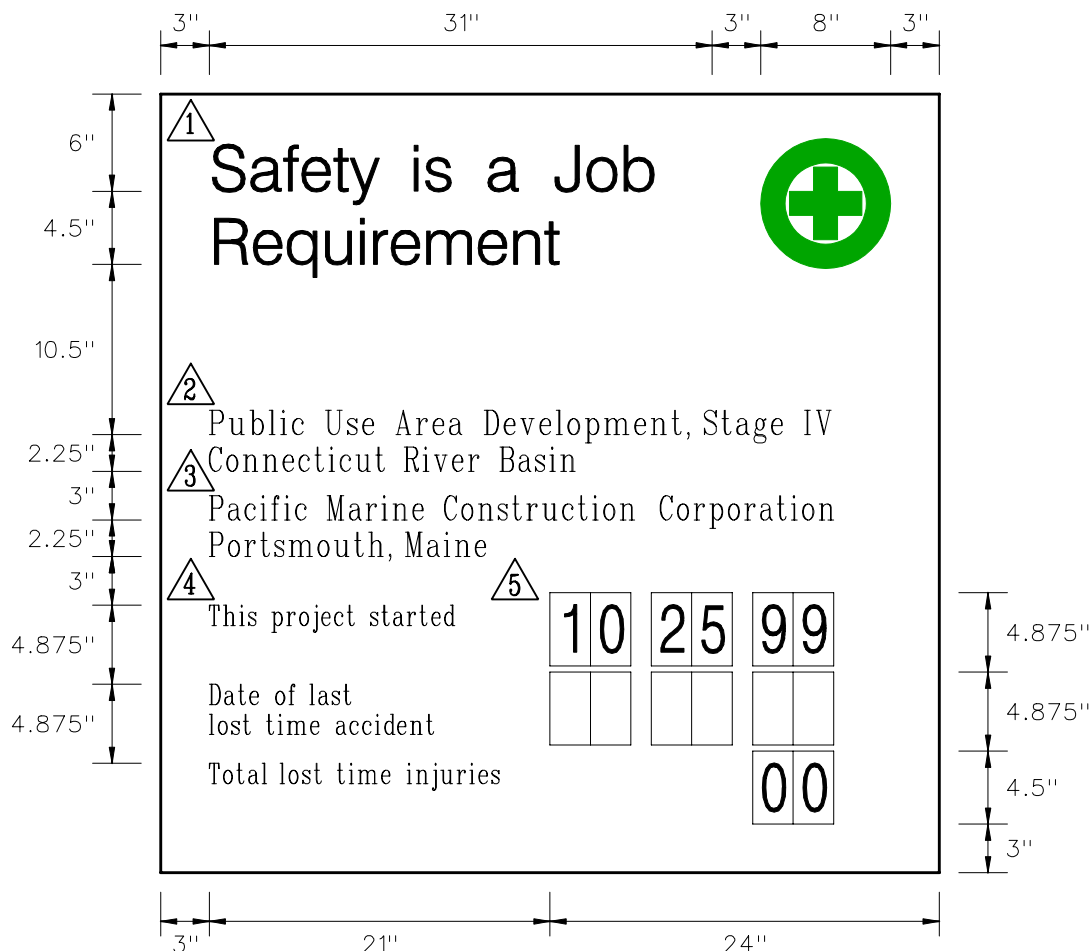
- ① One-to two-line description of Corps relationship to project. Color: White, Typeface: 1.25" Helvetica Regular, Maximum line length: 19".
- ② Division or District Name (optional). Placed below 10.5" reverse Signature (6" Castle). Color: White, Typeface: 1.25" Helvetica Regular.
- ②a One-to three-line identification of Military or Civil Works sponsor (optional). Place below Corps Signature to crossalign with Group 5a-b. Color: White, Typeface: 1.25" Helvetica Regular, Maximum line length: 19".
- ③ One-to three-line project title legend describes the work being done under this contract. Color: Black, Typeface: 3" Helvetica Bold, Maximum line length: 42".
- ④ One-to two-line identification of project or facility (civil works) or name of sponsoring department (military). Color: Black, Typeface: 1.5" Helvetica Regular, Maximum line length: 42".
- ⑤a One-to five-line identification of prime contractors including: type (architect, general contractor, etc.), corporate or firm name, city, state. Use of Legend Group 5 is optional.
- ⑤b Color: Black, Typeface: 1.25" Helvetica Regular, Maximum line length: 21".

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

STANDARD CONSTRUCTION DETAIL
PROJECT IDENTIFICATION SIGN
CIVIL WORKS PROJECT

1

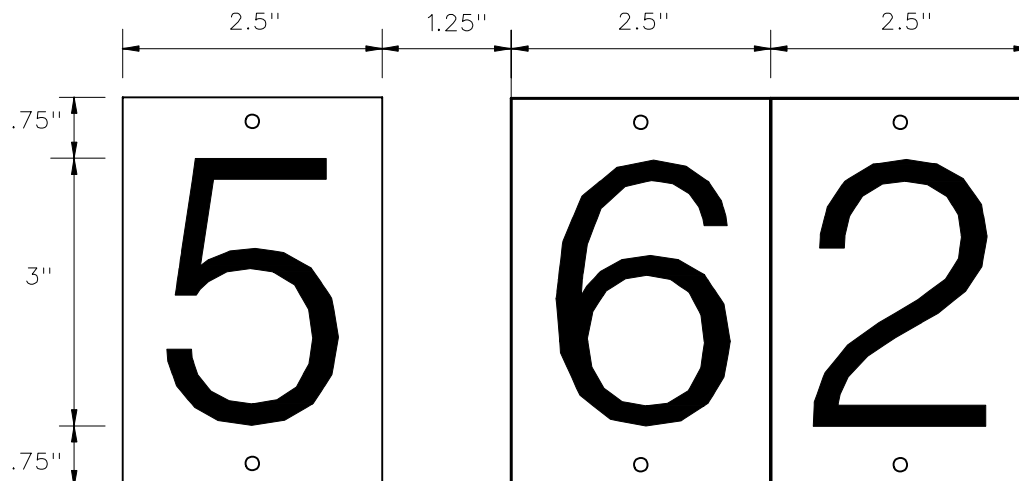
1



**NOTES:
LEGEND
GROUP**

DESCRIPTION

- 1** Standard two-line title: "Safety is a Job Requirement" with (8"OD.) Safety Green First Aid logo. Color: To match PMS 347, Typeface: 3" Helvetica Bold, Color: Black.
- 2** One-to two-line project title legend describes the work being done under this contract and name of host project. Color: Black, Typeface: 1.5" Helvetica Regular, Maximum line length: 42".
- 3** One-two-line identification: name of prime contractor and city, state address. Color: Black, Typeface: 1.5" Helvetica Regular, Maximum line length: 42".
- 4** Standard safety record captions as shown. Color: Black, Typeface: 1.25" Helvetica Regular.
- 5** Replaceable numbers are to be mounted on white .060 aluminum plates and screw-mounted to background. Color: Black, Typeface: 3" Helvetica Regular, Plate size: 2.5"x4.5".



NOTES:

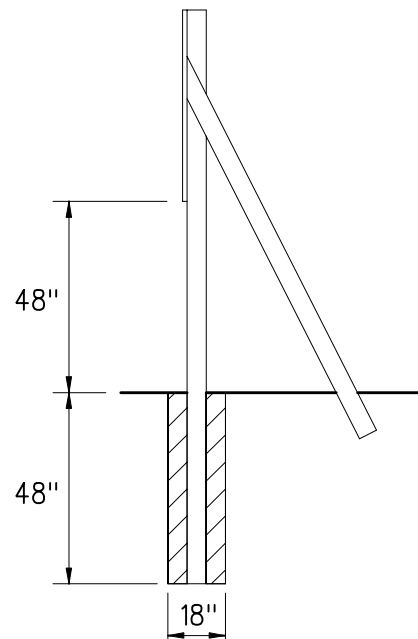
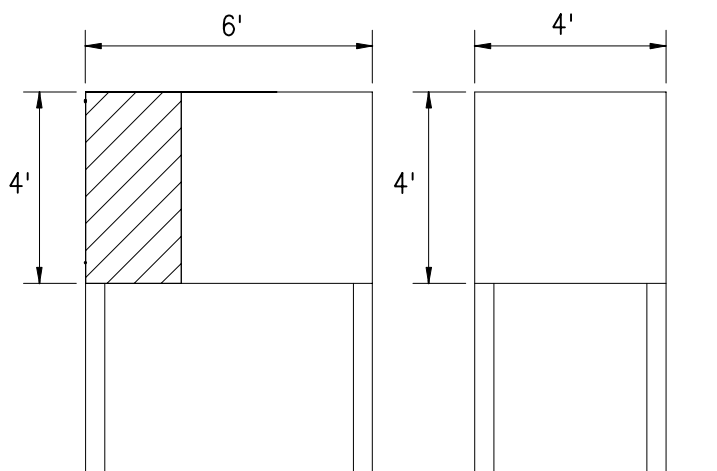
1. Replace numbers are to be mounted on white .0LD aluminum plates and serew-mounted to background of Safety Performance Sign.

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

STANDARD CONSTRUCTION DETAIL
INDIVIDUAL METAL PLATES
DETAIL

2

2



NOTES:

- 1 The sign panels are to be fabricated from .75" High Density Overlay Plywood. Panel preparation to follow HDO specifications provided in Appendix B.
- 2 Sign graphics to be prepared on a white non-reflective vinyl film with positionable adhesive backing.
- 3 All graphics except for the Communications Red background with Corps signature on the project sign are to be die-cut or computer-cut non-reflective vinyl, pre-spaced legends prepared in the sizes and typefaces specified and applied to the background panel following the graphic formats shown on pages 16.2-3.
- 4 The 2'x4' Communications Red panel (to match PMS-032) with full Corps signature (reverse version) is to be screen printed on the white background. Identification of the district or division may be applied under the signature with white cut vinyl letters prepared to Corps standards. Large scale reproduction artwork for the signature is provided on page 4.8 (photographically enlarge from 6.875" to 10.5").
- 5 Drill and insert six (6) .375" T-nuts from the front face of the HDO sign panel. Position holes as shown. Flange of T-nut to be flush with sign face.
- 6 Apply graphic panel to prepared HDO plywood panel following manufacturers' instructions.
- 7 Sign uprights to be structural grade 4"x4" treated Douglas Fir or Southern Yellow Pine, No.1 or better. Post to be 12' long. Drill six (6) .375" mounting holes in uprights to align with T-nuts in sign panel. Countersink (.5") back of hole to accept socket head cap screw (4"x.375").
- 8 Assemble sign panel and uprights. Imbed assembled sign panel and uprights in 4' hole. Local soil conditions and/or wind loading may require bolting additional 2"x4" struts on inside face of uprights to reinforce installation as shown.

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

STANDARD CONSTRUCTION DETAIL
FABRICATION AND MOUNTING GUIDELINES
MILITARY PROJECT

1

1

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 55 26

TRAFFIC REGULATION

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- 1.2 REFERENCES
- 1.3 SUBMITTALS
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 - 1.5.1 Signals
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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section Table of Contents --

SECTION 01 55 26

TRAFFIC REGULATION

PART 1 GENERAL

1.1 SUMMARY

Provide, operate, and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic and pedestrian flow during work in public streets, on walking paths and sidewalks, on haul routes, at site entrances, on-site access roads, and parking areas. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

MUTCD

Manual on Uniform Traffic Control Devices
for Streets and Highways, with
Massachusetts Amendments (2009, or most
current version at time of award)

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Traffic Control Plan; G, DO

The Contractor shall submit the details of the Traffic Control Plan to be implemented for this project for approval to the Contracting Officer. The submittal shall include drawings and a written narrative sufficient to fully describe all aspects of the Plan, including but not limited to the location of diversion devices, materials to be used, State and local police details, equipment to be used for automated traffic control, lighting, and other appropriate details. The Traffic Control Plan shall be in accordance with the applicable requirements of MUTCD, and Commonwealth of Massachusetts and local rules and regulations. The Traffic Control Plan shall address measures to be implemented for both vehicular and pedestrian traffic.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary

relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of police details, automated traffic control lights, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction, and as shown on the contract drawings. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the all State Police details and local police details and repair of any damage to roads caused by construction operations.

All required traffic lane closures shall be limited to the hours of 9:30 am to 3:00 pm.

In addition, traffic lane closures shall not be in place two hours prior to the scheduled start to one hour after the completion of Red Sox games, or any other major events scheduled at Fenway Park (e.g., concerts, etc.).

Traffic lane closures shall not be implemented on the Patriot's Day Holiday (from midnight to midnight).

1.4.1 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5 TRAFFIC SIGNALS AND SIGNS

1.5.1 Signals

Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.

1.5.2 Signs

Provide traffic control and directional signs, mounted on barricades or standard posts, as necessary. Safety signs for construction shall conform to the applicable requirements of regulations. All signs shall have high intensity encapsulated lens reflective sheeting.

1.5.3 Erection of Signs and Barricades

All necessary safety, destination, traffic control and construction signs and lighted barricades shall be in place and operational prior to the start of any work expected to have an adverse effect on traffic flow.

1.5.4 Temporary Covering of Erected Signs

Signs placed or erected prior to the actual commencement of the work shall be provided with suitable temporary covers. Immediately prior to the commencement of work, the applicable sign covers shall be completely removed from the signs.

1.6 LIGHTS

a. Provide lights during periods of low visibility to clearly delineate traffic lanes and to guide traffic and for use by police in directing traffic.

b. Provide illumination of critical traffic and parking areas.

1.7 CONSTRUCTION PARKING CONTROL

a. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Government inspectors operations, or construction operations.

b. Monitor parking of construction personnel's private vehicles to maintain free vehicular access to and through parking areas.

c. Prohibit parking on or adjacent to access roads, or in non-designated areas. Only vehicles directly involved with the construction operations, such as excavators, loaders, dump trucks, etc., are permitted within the limit of work. Privately owned vehicles not directly involved in the work, such as worker commuting vehicles, are not permitted within the limit of work or within the park.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 16

RODENT CONTROL

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- 1.4 COORDINATION
- 1.5 PERMITS

PART 2 PRODUCTS

- 2.1 PRODUCTS

PART 3 EXECUTION

- 3.1 MEETINGS
- 3.2 SURVEY
- 3.3 APPLICATION FOR RODENT CONTROL
 - 3.3.1 Surface Applications
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-- End of Section Table of Contents --

SECTION 01 57 16

RODENT CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section specifies rodent control and general pest control requirements within project areas, and bordering areas as designated by the Contracting Officer. This work shall be performed prior to demolition, excavation, and site preparation, and throughout the Contract, so that rodents do not disperse from or infest the project area.

The Contractor shall develop and implement an Integrated Pest Management (IPM) rodent control approach. The IPM approach shall rely as much as possible on traps rather than rodenticides to control rodents in existing and restored natural areas. Risk to non-target animals (pets and wildlife) shall be minimized to the extent practicable. As part of that approach, the Contractor shall maintain a cooperative dialogue with appropriate agencies.

The Contractor shall perform the rodent control tasks described in this section and in the approved work plan.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pest Control Work Plan; G, RO

After performing the survey described in Subpart SURVEY of Part 3, and before initiating control efforts, submit to the Contracting Officer for approval a Pest Control Work Plan describing proposed pest control procedures, indicating materials, quantities, methods, time schedule, personnel, and copies of pesticide applicator certifications and licenses.

SD-03 Product Data

EPA-approved Pesticide Label; G, RO

For all pesticides to be used, submit a copy of the pesticide manufacturer's EPA-approved pesticide label with application directions.

SD-11 Closeout Submittals

Submit to the Contracting Officer documentation of pest control activities and results as follows:

Weekly Data Sheets; G, RO

Submit weekly data sheets with locations of sites treated, amounts and types of pesticide used, number and types of traps set, survey and inspection results, sanitation conditions, complaint calls investigated, and any problem that occurred.

Monthly Written Summary; G, RO

Submit a monthly written summary that includes determinable results of the IPM program and recommendations.

Quarterly Map; G, RO

Submit a quarterly map that shows bait stations, manholes, and catch basins where rodent baits are being maintained.

1.3 QUALIFICATIONS

The Contractor shall perform this work at all times in accordance with the following minimum standards and as acceptable to the Contracting Officer.

A. The Contractor and key personnel shall have experience with commercial and residential accounts and construction projects; have experience and technical training in vertebrate pest management and integrated pest management; have experience with various rodent control techniques, equipment, and strategies; and have knowledge of and experience with techniques to reduce non-target hazards.

B. The supervisor shall be licensed and certified by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41) and Vertebrate Pest Control (category 44). The supervisor shall have specific training and experience in vertebrate pest management, commercial rodent control, general pest control, and integrated pest management.

C. Applicators shall be licensed by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41). Applicators shall have specific training and experience in commercial rodent control and integrated pest management.

1.4 COORDINATION

A. The Contractor shall perform the work of this section in cooperation with the other work performed under this Contract.

B. The Contractor shall initiate the work on or before field mobilization begins for this contract and with adequate timing to achieve control before environmental disruptions. Provide a maintenance program until this contract is completed and all equipment and materials are removed.

C. The Contractor shall perform the work according to the preliminary schedule described in this section and as accepted or revised by the Contracting Officer. Estimated durations and start dates may be changed by the Contracting Officer to suit changes in construction schedules and field conditions. The work could potentially require performance any day of the week and any hour of the day or night, regardless of weather.

D. The Contractor shall perform this work in such a manner that toxicant or other control tools do not pose a hazard to persons, domestic animals, or non-target wildlife.

E. The Pest Control Plan shall identify measures to be implemented to avoid impacts to non-target animals.

1.5 PERMITS

The Contractor shall obtain and maintain appropriate permit(s) from city or State agencies for pest control activities associated with this work.

PART 2 PRODUCTS

2.1 PRODUCTS

The Contractor shall furnish and use only pesticide formulations registered by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Food and Agriculture, where appropriate according to label directions and as acceptable to the Contracting Officer.

The Contractor shall furnish and use devices and supplies (e.g., traps and bait stations) to facilitate the management and effectiveness of the pest control program, where appropriate and as acceptable to the Contracting Officer.

PART 3 EXECUTION

3.1 MEETINGS

The Contractor's project supervisor shall meet with the Contracting Officer monthly to discuss pest control activities.

3.2 SURVEY

A. Prior to rodent control efforts, the Contractor shall survey the proposed construction area and accessible or observable bordering areas and record signs of rodent activity and sanitation conditions. Closely inspect all embankments, edge areas, and properties within the construction area. Maintain survey records in the manner described in Subpart RECORD KEEPING.

B. The Contractor shall thoroughly inspect construction areas and accessible or observable bordering areas and any nearby areas designated by the Contracting Officer for rodent activity and sanitation deficiencies weekly throughout the duration of this contract and in accordance with the work schedule. Maintain inspection records in the manner described in Subpart RECORD KEEPING.

C. The Contractor shall plan the control program and allocate resources based on survey and inspection data and as acceptable to the Contracting Officer.

3.3 APPLICATION FOR RODENT CONTROL

The Contractor shall apply rodenticide in strict accordance with EPA-approved label directions and the Rules and Regulations of the Massachusetts Department of Food and Agriculture. Maintain records of all bait placements in the manner described in Subpart RECORD KEEPING.

Where appropriate, especially for surface placements of rodent baits, use properly secured and tamper-resistant bait stations consistent with EPA regulation. Individually number and properly identify all bait stations.

3.3.1 Surface Applications

3.3.1.1 Initial Surface Trapping and Baiting

The Contractor shall rid the construction area of all detectable rodents before construction begins, or as acceptable to the Contracting Officer. Bait all observable rodent burrows. Install and secure traps and/or bait stations at regular and appropriate intervals and locations, and document rodent activity (burrows, droppings, bait consumed, dead rodents). Replenish bait and shift bait and trap stations as necessary to ensure complete control of rodent populations. Bait edge and accessible bordering areas as necessary to ensure that rodents will not be dispersed by construction activities and that rodents will not infest work areas.

3.3.1.2 Maintenance Surface Baiting

The Contractor shall establish a maintenance trapping/baiting program prior to mobilization by the Contractor, including construction areas and accessible bordering areas, as acceptable to the Contracting Officer. Check bait placements weekly. Use survey and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute bait and bait stations as appropriate to ensure continued control.

3.3.2 Subsurface Applications

3.3.2.1 General

For situations involving underground construction/demolition, utility relocation, or utility construction, and for other situations when determined necessary by the Contracting Officer, the Contractor shall initiate subsurface baiting and rid underground environments of all detectable rodents before construction begins. Assign an identifying number to each manhole and catch basin where bait is placed so that locations of bait placements can be identified and rodent activity (droppings, bait consumed, dead rats) can be documented. Conduct bait applications during off-peak traffic hours unless otherwise directed by the Contracting Officer. Access manholes according to the requirements of appropriate agencies and utility companies. Coordinate the work with appropriate municipal agencies and utility companies.

3.3.2.2 Initial Subsurface Baiting

The Contractor shall apply appropriate baits to control rodent populations in manholes and catch basins. This will involve suspending and securing bait using noncorrosive wire (e.g., 24 gauge plastic coated). Place bait in all accessible manholes and catch basins within the construction work area. In addition, bait an appropriate set of manholes and catch basins in the blocks bordering the work area and as acceptable to the Owner. Identify all baited manholes and catch basins with a standardized paint mark on the street and a numbered tag to be attached to the suspending wire. Approximately seven days after completion of the first baiting, check all manhole and catch basin baits and record estimates on the amount of bait consumed. Replenish or increase the amount of bait applied according to the amount consumed or as acceptable to the Contracting

Officer. Repeat this process again approximately fourteen days later and until there is little or no bait consumed. Check manholes and catch basins weekly when they repeatedly have 100 percent of the bait consumed.

3.3.2.3 Maintenance Subsurface Baiting

Prior to mobilization, the Contractor shall establish a maintenance baiting program appropriate for the rodent infestation patterns identified during initial subsurface baiting. This program shall ensure continued control and shall be performed in a manner acceptable to the Contracting Officer. Maintain bait in manholes and catch basins that have rodent activity and those that had activity during initial baitings. Check each bait according to rodent activity levels. This could range from weekly to approximately every three months, depending upon the recent history of bait consumption. Use utility maps and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute baiting locations as necessary to ensure adequate interception points for controlling immigrating rodents.

3.3.3 Cleanup

The Contractor shall remove visible rodent carcasses and dispose of them off-site daily consistent with the pesticide label directions and applicable codes, laws, and regulations.

Upon completion of any pest control operations at the site, the Contractor shall remove remaining traps and bait stations. Dispose of bait according to the pesticide label and applicable codes, laws, and regulations.

3.4 SANITATION

Prior to construction and throughout the duration of this contract, the Contractor shall identify and address harborage and food sources available to rodents on the construction site and in observable bordering areas. This includes any littering or improper or insufficient use of trash receptacles in construction areas. It also includes any bordering areas with sanitation conditions or structural deficiencies that violate City or State sanitation codes.

The Contractor shall maintain records of sanitation conditions in the manner described in Subpart RECORD KEEPING.

3.5 COMPLAINT CALLS

During construction, the Contractor shall respond to pest-related complaints from the "adjacent" neighborhood (i.e. within 200 feet of the project limits) within 12 hours, when directed by the Contracting Officer. Inspect the particular premises and adjacent areas for sanitation and structural deficiencies and also signs of historic and recent pest activity. Provide sanitation and structural maintenance information to the Contracting Officer. Use pesticides or traps as necessary and appropriate to resolve the complaint when there is a relationship between the pest infestation and construction activities, or when directed by the Contracting Officer.

The Contractor shall maintain records of all complaints investigated, including location, contact person, inspection results, and actions taken. Document the relatedness of the pest infestation to construction activities.

Signs shall be mounted on the construction fence in multiple locations showing a number to call with complaints.

3.6 GENERAL PEST CONTROL

When directed by the Contracting Officer, the Contractor shall determine appropriate methods for any pest control task not specifically identified above and shall submit them in writing to the Contracting Officer for approval in advance. Such pest control tasks would relate to unanticipated pest control needs within construction areas or adjacent areas. This could include control of insects or vertebrates other than rats and mice.

The Contractor shall maintain records of general pest control activities and results in the manner described in Subpart RECORD KEEPING.

3.7 RECORD KEEPING

The Contractor shall use standardized data sheets acceptable to the Contracting Officer to maintain accurate records of date, placement, type, and amount of pesticides or other control tools (e.g., traps) applied. Similarly, maintain records of surveys, inspections, changes in pest activity, sanitation conditions, and complaint calls. Submit data in a format acceptable to the Contracting Officer and as required in Subpart SUBMITTALS.

-- End of Section --

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SECTION 01 57 20

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 841-8-96-003 (1996) Quality Assurance Project Plans

U.S. ARMY (DA)

AR 200-5 Pest Management

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328 Definitions of Waters of the United States

40 CFR 152 - 186 Pesticide Programs

40 CFR 261 Identification and Listing of Hazardous Waste

40 CFR 262 Standards Applicable to Generators of Hazardous Waste

40 CFR 279 Standards for the Management of Used Oil

40 CFR 302 Designation, Reportable Quantities, and Notification

40 CFR 355 Emergency Planning and Notification

40 CFR 68 Chemical Accident Prevention Provisions

49 CFR 171 - 178 Hazardous Materials Regulations

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual that resides at a Project office and that is responsible for oversight of pesticide application on Project grounds.

1.2.5 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.6 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.7 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.8 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.9 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with

possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.10 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland has been made in accordance with the Order of Conditions from the City of Boston and Town of Brookline. The Contractor shall note that the entire project area is located in a wetland resource area and is on the National Register of Historic Places.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any cost and delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G, DO

The Contractor shall submit the Environmental Protection Plan. Contracting Officer review will be completed within 42 calendar days after date of submission of this Plan.

Fish Truck and Transport Plan; G, DO

If the Contractor proposes to install a barrier which obstructs upstream or downstream migration of adult blueback herring, a fish truck and transport plan must be submitted. The plan may be submitted as part of the Environmental Protection Plan.

Surface Water and Wastewater Quality Monitoring Plan; G, DO

The Contractor shall submit the Surface Water and Wastewater Quality Monitoring Plan.

SD-06 Test Reports

Test Results

The Contractor shall submit water quality sampling test results, for wastewater and surface water.

SD-11 Closeout Submittals

Fish Truck and Transport Plan Truck Monitoring Reports; G, DO

If the Contractor proposes to install a barrier which obstructs upstream or downstream migration of adult blueback herring, and a fish truck and transport plan is employed, the Contractor shall submit Fish Truck and Transport Plan Monitoring Reports as described in the attached draft conceptual plan. The reports shall be submitted for any final plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

- a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
- b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
- c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
- d. Description of the Contractor's environmental protection personnel training program.
- e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan. See Section 01 57 23 STORM WATER POLLUTION PREVENTION MEASURES for additional requirements.
- f. Drawings showing locations of proposed material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to contain materials on the site.
- g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.
- h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
- i. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:
 1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.
 2. The name and qualifications of the individual who will be

responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

j. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal. Coordinate with the requirements of Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

(1) Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

(2) Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Submit the report for the previous quarter on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted (e.g. the first working day of January, April, July, and October).

(3) Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

(4) A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

k. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

l. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and detailed provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are

brought on site or removed from the site, the plan shall be updated.

m. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water and clean-up water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge. The Contractor shall obtain permits from the MWRA 8M; TRAC permit if discharging of waste water to a CSO for dewatering.

n. A historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources, and wetlands known to be onsite. The plan shall include methods to assure the protection of all resources known or discovered and shall identify lines of communication between Contractor personnel and the Contracting Officer.

o. A pesticide treatment plan, if necessary, shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional specific requirements. The Contractor shall follow [AR 200-5](#) Pest Management, Chapter 2, Section III "Pest Management Records and Reports" for data required to be reported to the Installation.

p. A plan for capture and relocation of freshwater fish, turtles, and mussels trapped in sections of the Riverway and Back Bay Fens that are dewatered by construction activities. The Contractor will be required to have the plan approved by and obtain collecting permit from the MA Division of Fish and Wildlife. Due to salinity, electrofishing is not expected to be a viable fish capture method in the Back Bay Fens. Relocation of mussels shall focus on individuals which can be readily captured from near shoreline after dewatering.

q. A plan to assure that blueback herring (*Alosa aestivalis*) can complete their spring upstream adult spawning migration and fall downstream out-migration of juveniles. The river must be free flowing during the September 15 to November 1 juvenile outmigration period of any year. Unobstructed adult upstream and downstream migration shall occur between April 1st to June 15th to the extent practicable. If the Contractor proposes to install a barrier which obstructs upstream or downstream migration of adult blueback herring, a [fish truck and transport plan](#) must be submitted for approval by the U. S. Army Corps of Engineers, NOAA Fisheries, and the MA Department of Marine Resources. The truck and transport plan shall be operational for no more than 2 spring adult migratory seasons. A draft conceptual truck and transport plan is provided as an attachment to this specification. The Contractor shall submit [Fish Truck and Transport Plan Monitoring Reports](#) as described in the attached draft conceptual plan. The Monitoring Reports shall be submitted as part of any final truck and transport plan.

1.7.3 Appendix

Copies of all environmental permits, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

1.8 SURFACE WATER AND WASTEWATER QUALITY MONITORING PLAN

The Contractor shall prepare a plan for monitoring compliance with water and wastewater quality and discharge standards (see Subpart 3.3.2 "Waste Water Discharge Standards"). The plan shall include the following elements:

1. List of parameters to monitor, detection limits, and discharge standards.
2. Sampling method.
3. Frequency of wet and dry weather monitoring.
4. Monitoring locations (including a map).
5. Reporting.
6. List of Personnel, Roles and Responsibilities.
7. Analytical Laboratory.
8. Equipment required.
9. Safety Plan.
10. Quality Assurance Project Plan (QAPP), in accordance with the requirements of EPA 841-8-96-003.

1.9 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection, along with the condition of trees, shrubs, and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the contract drawings and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and from resource agencies and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer and the resource agencies determine that the proposed alternate method will have an adverse environmental impact or impacts established project completion dates.

1.11 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or

regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law. This does not relieve the Contractor of the responsibility of monitoring all work for compliance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

This Article supplements the Contractor's responsibility under the contract clause PERMITS AND RESPONSIBILITIES to the extent that environmental permits have been issued for this project. A Water Quality Certificate and Waterways License, Orders of Conditions issued by Boston and Brookline for this project, and letters of approval from the Boston and Brookline Landmark Commissions, are attached at the end of this section. The Contractor shall comply with permit terms and conditions that are applicable to this contract. Such applicable terms and conditions are specified in the various sections of these specifications and on the contract drawings. The above referenced documents shall not be relied on for contract requirements. In the event a discrepancy is discovered between the reference documents and these specifications or the contract drawings, the Contractor shall notify the Contracting Officer for clarification. The Contracting Officer will rely on permit requirements and conditions to resolve perceived conflicts.

Obtaining other permits and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations is the Contractor's responsibility. Among these other permits, the Contractor shall note that an NPDES Construction General Permit is required and has not been obtained by the Government.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the contract drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Other land resources to protect include, but are not limited to, bridges, roadways, sidewalks, unpaved pathways, curbs, utilities, and signage. Stone, soil, or other materials displaced into non-construction areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the

areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Protection of Existing Vegetation

A. The Contractor shall make every effort not to damage existing plant materials to remain. The Contractor is required to install fencing to protect above ground plant material and the critical root zone of trees. The Critical Root Zone (CRZ) is three feet outside the perimeter of the leaf canopy of the tree to be protected. This area shall not be disturbed during construction operations.

B. Plants as designated on the contract drawings or by the Contracting Officer to remain shall be protected by the placement of a tree protection fence enclosure around shrubs, or at the critical root zone of each tree or group of trees. Place tree protection additionally at all other locations where trees and/or shrubs may be jeopardized by construction activities. Trees, vines, groundcover and shrubs to be saved within the contract limits and elsewhere as designated shall be protected with a protection fence. An arborist and the Contracting Officer shall approve location of tree fence in the field.

C. Damage no plants to remain by burning, by pumping of water, by cutting live roots or branches, soil compaction, or by any other means. No plants to be saved shall be used for crane stay, guys or other fastenings. Vehicles shall not be driven or parked within the critical root zone or where damage may result to trees to be saved. Construction materials and equipment shall never be stored beneath the leaf canopy of trees, except as noted on the contract drawings.

D. Protection of vegetation shall remain in place and be maintained in working condition by the Contractor until directed for removal by the Contracting Officer. All protection devices shall be removed from the site by the Contractor as directed by the Contracting Officer or Arborist. See the contract drawings for root protection requirements.

E. Existing trees and shrubs to be saved or protected within or outside the contract limits which, in the opinion of the Contracting Officer, become damaged shall be repaired or replaced as recommended by the Arborist and approved by the Contracting Officer. Repair is preferred if long-term survival and growth of the plant is likely as determined by the Arborist. Repairs may include wound treatments, cabling, bracing, pruning, fertilizing, watering, aeration, alleviation of compacted soil, other soil practices, insect and disease treatments, and other measures to assure long term survival and growth of the affected plant. If the plant is damaged beyond repair it shall be removed and replaced. Removal shall include removal and off-site disposal of aboveground vegetation and stumps, restoration of the ground surface, and seeding. Tree replacement shall include installation of the largest caliper diameter specimen obtainable for the species from a New England region nursery. Two shrubs shall be planted for each shrub damaged beyond repair. Trees greater than 6" in diameter shall be replaced with 3 trees. Trees greater than 12" in diameter shall be replaced with 6 trees. Trees greater than 24" in diameter shall be replaced with 12 trees. The replacement trees shall be

planted on-site or at off-site locations in Boston or Brookline. On-site locations shall be approved by the Contracting Officer. Off-site locations shall be approved by the Contracting Officer and the Boston or Brookline Parks Department.

All costs associated with the repair, removal and replacement of damaged trees and shrubs shall be borne by the Contractor without additional cost to the Government. These costs include but are not limited to the cost of the Arborist evaluation, repairs and monitoring, removal of vegetation, replanting, and maintenance of planted material during an establishment and guarantee period.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the contract drawings and as specified in Section 01 57 23 STORM WATER POLLUTION PREVENTION MEASURES. BMPs may include, but not be limited to, vegetation cover, slope stabilization, silt fences, sediment traps, and inlet and outfall protection. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the contract drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

3.3.1 Treatment and Disposal of Wastewater

Do not discharge water from dewatering operations directly into the Muddy River, the storm drain system, or the Muddy River Conduit. Water from dewatering operations shall be treated by filtration, settling basins, or other approved methods to reduce the amount of sediment and contaminants contained in the water to allowable levels.

Water that has been used for washing or processing shall not be directly or indirectly returned to the surface water without treatment. Divert such waters through a settling basin and filtration system before discharging into the river, water diversion system, or storm drain system.

The quality of wastewater discharged on site shall meet or exceed waste water discharge standards.

3.3.2 Waste Water Discharge Standards

The following standards shall apply to wastewater discharged directly or indirectly into the Muddy River or Back Bay Fens.

<u>Parameter</u>	<u>Discharge Standard</u>
Total Suspended Sediments	< 40 milligram/liter
Dissolved Lead	< 1.0 microgram/liter above background
DO	> 5.0 milligrams/liter

3.3.3 Water Quality Monitoring

3.3.3.1 General

Water quality sampling, testing, and reporting shall be performed as specified in Subpart SURFACE WATER AND WASTEWATER QUALITY MONITORING PLAN.

The water quality monitoring shall commence at the start of any site work and shall continue during all phases of construction including excavation, dewatering, and site restoration.

The Contractor shall submit lab reports and field data sheets to the Contracting Officer. Results shall be reported to the Contracting Officer within 48 hours of sampling for all parameters except dissolved lead, which shall be reported within 72 hours.

At completion of the sampling, [test results](#) shall be summarized in a draft report submitted to the Contracting Officer for review and Approval.

3.3.3.2 Wastewater

Treated wastewater from dewatering, dredged material processing operations or other activities that is discharged directly or indirectly into surface water shall be testing daily for TSS and weekly for dissolved lead. Surface water pumped through bypass pipes is not considered wastewater.

3.3.3.3 Surface Waters

Surface water sampling is required upstream and downstream of dewatered areas. Surface water shall be tested weekly during dry weather for temperature, dissolved oxygen, turbidity, and conductivity.

Additional wet weather sampling shall be required when rainfall is predicted to exceed 0.50 inch in a 24 hour period. Wet weather sampling shall be performed for same parameters and at same locations as the dry weather sampling. Sampling shall occur at 4 hour intervals starting just prior to the commencement of a storm event and finishing after the rain has ended and stormwater runoff has subsided.

3.3.4 Wetlands

Work in wetlands shall be limited to the work areas shown on the contract drawings.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and

performance laws and standards.

3.4.1 Particulates

Dust particles, aerosols and gaseous by-products from construction activities and processing and preparation of materials, such as from asphaltic batch plants, shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the Commonwealth of Massachusetts rules. Additionally, the Contractor's operations and equipment shall comply with the noise standards of the City of Boston Municipal Code (Chapter 16, Section 26). When the Contractor's operations or equipment is located within the Town of Brookline or sufficiently close the border of the Town of Brookline so that the noise emitted by the Contractor's operations could negatively impact the quality of life within the Town of Brookline, the Contractor's operations and equipment shall comply with the Noise Control By-law of the Town of Brookline. The Contractor shall monitor noise levels as necessary to ensure compliance with these requirements.

3.4.4 Burning

Burning is prohibited on the project site.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the contract drawings.

3.5.1 Solid Wastes

Solid wastes shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off the project site and off Government property and dispose of it in compliance with Federal, State, and local

requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off of the project site and off of Government property within 30 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. There shall be no storage of fuel on the project site. Fuel must be brought to the project site each day that work is performed. Also refer to Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, Subpart "Storage of Hazardous Materials". The Contractor shall maintain a spill kit on the project site at all times. Refer to Order of Conditions for other refueling requirements.

3.5.5 Waste Water

Waste water from construction activities, such as onsite material processing, concrete curing, concrete clean-up, water used in concrete trucks, forms, etc., clean-up water shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off of the project site and off of Government property in accordance with all Federal, State, Regional and Local laws and regulations.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Plastic plant pots shall be returned to the nursery if the nursery accepts them for reuse.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

See Section 02 42 91 HISTORIC, ARCHAEOLOGICAL AND CULTURAL RESOURCES.

3.8 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species, including their habitat, in accordance with Federal, State, Regional, and local laws and regulations.

3.9 INTEGRATED PEST MANAGEMENT

The use and management of pesticides are regulated under 40 CFR 152 - 186.

See Section 32 94 00 INVASIVE PLANT CONTROL for related requirements.

3.9.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.9.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.9.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS) shall be available for all pesticide products.

3.9.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.10 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds.

3.11 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Temporary construction material and signs shall be removed. The disturbed area shall be graded, filled and the entire area seeded (see Section 32 92 19 SEEDING) unless otherwise indicated.

3.14 ENVIRONMENTAL ASSESSMENT

An Environmental Assessment (EA), including a "Finding of No Significant Impact", was prepared and approved for the Muddy River Flood Control and Ecosystem Restoration Project. The scope of the EA encompasses both Phase I and Phase II (this contract) work.

-- End of Section --

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SECTION 01 57 23

STORM WATER POLLUTION PREVENTION MEASURES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4439	(2011) Geosynthetics
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 GENERAL

The Contractor shall implement the storm water pollution prevention measures specified in this section in a manner which will meet the requirements of Section 01 57 20 ENVIRONMENTAL PROTECTION.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Mill Certificate or Affidavit.

Certificate attesting that the Contractor has met all specified requirements.

1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

1.4.1 Stabilization Practices

The stabilization practices to be implemented shall include silt fences, staked hay bale barriers, silt sacks, temporary seeding, mulching, geotextiles, protection of trees, preservation of mature vegetation, or other appropriate measures chosen by the Contractor. On his daily CQC Report, the Contractor shall record the dates when the major earth-moving activities occur, (e.g., tree and stump removal, excavation, placing fill, etc.); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 5 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 3 days after activities have temporarily or permanently ceased, in any portion of the site.

1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.4.1.2 No Activity for Less Than 5 Days

Where construction activity will resume on a portion of the site within 5 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 5 days), then stabilization practices do not have to be initiated on that portion of the site after construction activity temporarily ceased.

1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include silt fences, straw bale barriers, silt sacks, straw waddles, compost socks, or other approved devices as chosen by the Contractor. Location and details of installation and construction shall be as required by the Contractor's construction methods to limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall include the following devices (silt fences, straw bale barriers, silt sacks), and may be required to be used independently or in conjunction as the conditions of the site require.

1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g., tree and stump removal, excavation, etc.). Silt fences shall be installed at the locations shown on the contract drawings and as required by the Contractor's construction methods. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

1.4.2.2 Straw Bales

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g., tree and stump removal, grading, excavation, etc.), and in each independent runoff area. Bales shall be placed as work progresses and shall be removed/replaced/relocated as needed for work to progress in the drainage area. Straw bales shall be installed in the locations indicated on the contract drawings and as required by the Contractor's construction methods. Final removal of straw bale barriers shall be upon approval by the Contracting Officer. Rows of bales of straw shall be provided as follows:

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.
- c. Along the toe of all cut slopes and fill slopes of the construction areas.
- d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc., that traverse disturbed areas or carry runoff from disturbed areas.
- e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales.
- f. At the entrance to culverts that receive runoff from disturbed areas.

The Contractor may substitute straw wattles for the straw bales with Contracting Officer approval

1.4.3 Silt Sacks

The Contractor shall provide silt sacks as a temporary structural practice to minimize erosion and sediment runoff. Silt sacks shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g., tree and stump removal, excavation, etc.). Silt sacks shall be installed at the locations shown on the contract drawings and as required by the Contractor's construction methods. Final removal of silt sack barriers shall be upon approval by the Contracting Officer.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

The geotextile shall comply with the requirements of [ASTM D4439](#), and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to

deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile Elongation (%)	ASTM D4632	100 lbs. min. 30 % max.
Trapezoid Tear	ASTM D4533	55 lbs. min.
Permittivity	ASTM D4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D4751	20-100

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D4873.

2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as byhalia, bermuda, etc., furnished in air dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

2.3 SILT SACKS

Silt sacks shall be made from biodegradable materials and filled with wood chip compost. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

3.2 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

3.3 INSTALLATION OF SILT SACKS

Silt sacks shall be placed lengthwise on the contour. Silt sacks shall be securely anchored by stakes driven through the sack every four feet. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

3.4 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures

and other protective measures. The following procedures shall be followed to maintain the protective measures.

3.4.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded.

3.4.2 Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier. Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded.

3.4.3 Silt Sack Maintenance

Silt sacks shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damages. Necessary repairs to shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the installed sack. Silt sack runs used to retain sediment shall be turned uphill at each end of each run. When a silt sack is no longer required, it shall be removed. The immediate area occupied by the sack and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded.

3.5 INSPECTIONS

3.5.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

3.5.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control

measures identified in the Storm Water Pollution Prevention Plan (see Section 01 57 20 ENVIRONMENTAL PROTECTION, subpart "Environmental Protection Plan") shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

3.5.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

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PART 3 EXECUTION (Not Used)

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SECTION 01 71 23

FIELD ENGINEERING

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Engineering Services

The Contractor shall provide and pay for field engineering services required for the project, including the following:

- a. Survey work required in execution of the project and for determining quantities of work performed for submission of progress payment requisitions.
- b. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.

1.1.2 Existing Control Points

The Contracting Officer's Representative will identify existing control points indicated on the contract drawings, as required.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Qualifications

Name and address of the Surveyor and proof of registration.

SD-06 Test Reports

As-Built Cross-Sections; G, RO

The Contractor shall submit as-built cross-sections in accordance with this specification section.

1.3 QUALIFICATIONS

1.3.1 Registered Land Surveyor

Registered land surveyor, licensed in the Commonwealth of Massachusetts, and approved by the Contracting Officer.

1.4 LAYOUT OF WORK

- a. The Government has established bench marks and horizontal control

points at the site of the work. These are described and indicated on contract drawings.

b. From these control points the Contractor shall lay out the work by establishing all lines and grades at the site necessary to control the work and shall be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on the contract drawings. The Contractor shall establish and maintain at the site of the work such stakes and markers as are necessary for control and guidance of his construction operations. All survey data shall be recorded in accordance with standard and approved methods. All field notes, sketches, recordings and computations made by the Contractor in establishing above horizontal and vertical control points shall be available at all times during the progress of the work for ready examination by the Contracting Officer or his duly authorized representative.

c. The Contractor shall furnish, at his own expense, all such stakes, spikes, steel pins, templates, platforms, equipment, tools and material and all labor as may be required in laying out any part of the work from the control points established by the Government. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other markers established by him until authorized to remove them. If any of the control points established at the site by the Government are destroyed by or through the negligence of the Contractor prior to their authorized removal, they may be replaced by the Contracting Officer, and the expense of replacement will be deducted from any amount due or which may become due the Contractor. The Contracting Officer may require that work be suspended at any time when horizontal and vertical control points established at the site by the Contractor are not reasonably adequate to permit checking the work. Such suspension will be withdrawn upon proper replacement of the control points.

d. During the layout of the work, the Contractor shall notify the Government of any inconsistencies or conflicts which arise due to the supplied control points or features of the project.

1.5 REAL TIME MONITORING

The Contractor shall do real time monitoring of project progress by utilizing RTK GPS capable of centimeter-level accuracy on the excavator. A base station shall be established in the vicinity of the project. Alternatively, use of an established network base station is also acceptable. Regardless of the base station used, a minimum of 2 horizontal and vertical calibrations shall be done daily on a known, verified control point. All calibrations, equipment used, coordinates of base stations, and any other pertinent information to the GPS system used shall be documented in a field book, and made available if requested by the Government. Project templates shall be loaded into the GPS rover during the real time monitoring to verify project progress. An additional GPS rover with the imported project template files shall be made available to the government for real time monitoring quality assurance. The Contractor shall train the government field staff to effectively use the GPS rover. The Contractor shall also be available to troubleshoot any technical issues with the GPS rover.

1.6 AS-BUILT CROSS-SECTIONS

a. Once excavation of river sediment begins, the Contractor shall take

survey cross-sections of the excavated areas perpendicular to the river flow at 20 foot intervals. The cross-sections are to illustrate progress with the excavation work and shall include reporting the approximate volume of material excavated. Cross sections shall be submitted for approval to the Contracting Officer at a minimum for each two cross-sections completed or every five work days, whichever occurs first. A registered land surveyor, licensed in the Commonwealth of Massachusetts, is not required for these surveys and cross-sections. These cross-sections do not constitute final acceptance of excavated areas. For final acceptance requirements, see Paragraph "f" of this subpart.

b. The survey shall include at least seven survey points at each cross section location including tops of channels and banks, toes of slopes, centerline, and two interior points.

c. All survey data taken for as-built cross-sections shall be recorded in accordance with standard and approved methods. All field notes, sketches, recordings and computations made in establishing the horizontal position and elevations at each survey point shall be included with the as-built cross-section submittal.

d. If additional cross-section points are needed to accurately depict excavated areas, the survey shall collect the data and include it on the section.

e. As-built cross sections, plans, and profiles shall be produced in CAD software (".dgn" or ".dwg" format) and submitted digitally. All data captured for as-built cross-sections, plans, and profiles shall also be submitted as a CSV text file with data formatted in a "x,y,z" + "description" format.

f. Upon the completion of all of the excavation in a specific and distinct work area as shown on the contract drawings (i.e., Areas 1 through 12), as-built cross-sections as described in Part "a" through "e" of this subpart shall be taken again for the entire area, and submitted to the Contracting Officer for approval. These surveys and cross-sections shall be performed by a registered land surveyor, licensed in the Commonwealth of Massachusetts. Approval of these final as-built cross-sections by the Contracting Officer constitutes approval of the completion of excavation in the specific work area, at which time temporary water diversion features shall be removed. The Contractor will not be required to perform additional excavation in this work area once this approval has been received.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

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SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G, RO

The Contractor shall develop a Waste Management Plan in accordance with the requirements of this section.

1.4 MEETINGS

Conduct Construction Waste Management meetings. After award of the

Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00 QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

- a. Preconstruction meeting.
- b. Regular QC meetings.
- c. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after Notice to Proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
- c. Description of the regular meetings to be held to address waste management.
- d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.
- e. Characterization, including estimated types and quantities, of the waste to be generated.
- f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
- g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.
- h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.
- i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit the Waste Management Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.6 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 20 ENVIRONMENTAL PROTECTION. Separate materials by one of the following methods:

1.6.1 Source Separated Method

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

- a. Land clearing debris.
- b. Asphalt.
- c. Concrete and masonry.
- d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper,

zinc, lead brass, bronze).

(1) Ferrous.

(2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.6.2 Co-Mingled Method

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.6.3 Other Methods

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.7 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.7.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered.

1.7.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.7.3 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.7.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

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PART 3 EXECUTION (NOT USED)

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

As-Built Drawings; G, DO.

Drawings showing final as-built conditions of the project. The CADD drawings shall consist of 2 sets of completed final as-built drawings on separate media. One set of media shall be CADD drawing files. The other set of media shall consist of one set of mylars, 2 sets of blue line prints of the mylars, and the approved marked working as-built prints.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings", "contract drawings", "drawing files", "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in Microstation V8i, revised to reflect all bid amendments, will be provided by the Government at the Preconstruction Conference.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of specific phases of work, as appropriate for the project. The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to incremental submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress

payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show the following information, as appropriate, but not be limited thereto:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

c. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment, foundations, etc.

d. The topography, invert elevations, and grades of drainage installed or affected as part of the project construction.

e. Changes or modifications which result from the final inspection.

f. If Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

g. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and comply with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing, (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 12.7 mm (1/2 inch) diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, adding such additional drawings as may be necessary. At the time of final inspection, 3 copies of the working as-built prints shall be delivered to the Contracting Officer for review and approval. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, level conventions, and symbols shall be the same as the original line colors, line weights, lettering, level conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same guidance specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files with the same file format as the original drawing files. The Contractor will be furnished CADD drawing files in electronic digital (Microstation V8i) format constructed on a PC using a Windows operating system. The Contractor shall be responsible for providing all software and hardware necessary to prepare final as-built drawings in Microstation V8i. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the same as the existing electronic CADD files furnished.

Special Notes (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the level as the original item. Special notes shall be in blue on a unique level.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 5 mm (3/16 inch) high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more

revisions. Original contract drawings shall be dated in the revision block.

d. After receipt by the Contractor of the approved working as-built prints and approval of completed sections of final as-builts the Contractor shall, within 20 workdays, make the final as-built submittal. This submittal shall consist of 2 sets of electronic files on compact disks (the use of other media must be approved by the Contracting Officer), one set of mylars, and two sets of full size prints of these drawings and the return of the approved marked working as-built prints. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor.

1.2.2 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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- 3.1.1 Training Plan
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- 3.1.3 Training Outline
- 3.1.4 Unresolved Questions from Attendees
- 3.1.5 Validation of Training Completion
- 3.1.6 Quality Control Coordination

-- End of Section Table of Contents --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

O&M Database; G, RO

Training Plan; G, RO

Training Outline; G, RO

Training Content; G, RO

SD-11 Closeout Submittals

Validation of Training Completion; G, RO

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.2.2 Package Content

Provide data package content in accordance with paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Use Data Package 3 for commissioned items without a specified data package requirement in the individual technical sections. Provide a Data Package 3 instead of Data Package 1 or 2, as specified in the individual technical

section, for items that are commissioned.

1.2.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.3 O&M DATABASE

Develop an editable, electronic spreadsheet based on the equipment in the Operation and Maintenance Manuals that contains the information required to start a preventive maintenance program. As a minimum, provide list of system equipment, location installed, warranty expiration date, manufacturer, model, and serial number.

1.4 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete electronically linked operation and maintenance directory.

1.4.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.4.2 CD or DVD Label and Disk Holder or Case

Provide the following information on the disk label and disk holder or case:

- a. Building Number
- b. Project Title
- c. Activity and Location
- d. Construction Contract Number
- e. Prepared For: (Contracting Agency)
- f. Prepared By: (Name, title, phone number and email address)
- g. Include the disk content on the disk label
- h. Date
- i. Virus scanning program used

1.5 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items listed in paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Use as applicable to project requirements.

1.5.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.5.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.5.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.5.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.5.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.5.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.5.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.5.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.5.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.5.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.5.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.5.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

- a. Define the anticipated time required to perform each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.
- b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.5.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.5.3.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.5.3.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.5.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.5.3.4 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.5.3.5 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.5.3.6 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.5.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.5.4.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the required approval.

1.5.4.2 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.5.4.3 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals documented with the required approval.

1.5.4.4 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.5.4.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components of the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.4.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.4.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.5.4.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.5.4.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.5.4.10 Field Test Reports

Provide a copy of Field Test Reports (SD-06) submittals documented with the required approval.

1.5.4.11 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. The information required in each type of data package follows:

1.6.1 Data Package 1

- a. Safety precautions and hazards
- b. Cleaning recommendations
- c. Maintenance and repair procedures
- d. Warranty information
- e. Extended warranty information
- f. Contractor information
- g. Spare parts and supply list

1.6.2 Data Package 2

- a. Safety precautions and hazards
- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan, schedule, and procedures
- f. Cleaning recommendations
- g. Maintenance and repair procedures
- h. Removal and replacement instructions
- i. Spare parts and supply list
- j. Parts identification

- k. Warranty information
- l. Extended warranty information
- m. Contractor information

1.6.3 Data Package 3

- a. Safety precautions and hazards
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Environmental conditions
- g. Operating log
- h. Lubrication data
- i. Preventive maintenance plan, schedule, and procedures
- j. Cleaning recommendations
- k. Troubleshooting guides and diagnostic techniques
- l. Wiring diagrams and control diagrams
- m. Maintenance and repair procedures
- n. Removal and replacement instructions
- o. Spare parts and supply list
- p. Product submittal data
- q. O&M submittal data
- r. Parts identification
- s. Warranty information
- t. Extended warranty information
- u. Testing equipment and special tool information
- v. Testing and performance data
- w. Contractor information
- x. Field test reports

1.6.4 Data Package 4

- a. Safety precautions and hazards

- b. Operator prestart
 - c. Startup, shutdown, and post-shutdown procedures
 - d. Normal operations
 - e. Emergency operations
 - f. Operator service requirements
 - g. Environmental conditions
 - h. Operating log
 - i. Lubrication data
 - j. Preventive maintenance plan, schedule, and procedures
 - k. Cleaning recommendations
 - l. Troubleshooting guides and diagnostic techniques
 - m. Wiring diagrams and control diagrams
 - n. Repair procedures
 - o. Removal and replacement instructions
 - p. Spare parts and supply list
 - q. Repair work-hours
 - r. Product submittal data
 - s. O&M submittal data
 - t. Parts identification
 - u. Warranty information
 - v. Extended warranty information
 - w. Personnel training requirements
 - x. Testing equipment and special tool information
 - y. Testing and performance data
 - z. Contractor information
 - aa. Field test reports
- 1.6.5 Data Package 5
- a. Safety precautions and hazards
 - b. Operator prestart

- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan, schedule, and procedures
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Product submittal data
- m. Manufacturer's instructions
- n. O&M submittal data
- o. Parts identification
- p. Testing equipment and special tool information
- q. Warranty information
- r. Extended warranty information
- s. Testing and performance data
- t. Contractor information
- u. Field test reports

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the Operation and Maintenance Manual submitted in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS. Training must include classroom or field lectures based on the system operating requirements. Training shall be recorded and submitted on DVD. The location of classroom training requires approval by the Contracting Officer.

3.1.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Quality Control Manager (QC) prior to forwarding to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

- a. Equipment included in training
- b. Intended audience
- c. Location of training
- d. Dates of training
- e. Objectives
- f. Outline of the information to be presented and subjects covered including description
- g. Start and finish times and duration of training on each subject
- h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)
- i. Instructor names and instructor qualifications for each subject
- j. List of texts and other materials to be furnished by the Contractor that are required to support training
- k. Description of proposed software to be used for video recording of training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC is responsible for overseeing and approving the content and adequacy of the training. Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

- a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.
- b. Relevant health and safety issues.
- c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.
- d. Design intent.
- e. Use of O&M Manual Files.
- f. Review of control drawings and schematics.
- g. Interactions with other systems.

- h. Special maintenance and replacement sources.
- i. Tenant interaction issues.

3.1.3 Training Outline

Provide the Operation and Maintenance Manual Files (Bookmarked PDF) and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the attendees, and the training recording must be modified to include the appropriate clarifications.

3.1.5 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.6 Quality Control Coordination

Coordinate this training with the QC in accordance with Section 01 45 00 QUALITY CONTROL.

-- End of Section --

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DIVISION 02 - EXISTING CONDITIONS

SECTION 02 40 00

CONTROL AND DIVERSION OF WATER

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-- End of Section Table of Contents --

SECTION 02 40 00

CONTROL AND DIVERSION OF WATER

PART 1 GENERAL

1.1 SUMMARY

The work covered by this section of the specifications consists of furnishing all plant, labor, and materials and performing all work in connection with the control and diversion of the Muddy River, dewatering and control of subsurface water within cofferdams, control of water past or through work areas, control of surface drainage, and temporary diversion structures. This work may include but is not limited to: design, construction, operation, maintenance, and removal of temporary cofferdams; provision, installation, operation, maintenance, and removal of piping, pumps, equipment and supports, etc.; excavation and maintenance for diversion piping or channels; slope protection; and temporary site drainage facilities.

1.2 CONTRACTOR QUALIFICATIONS

The control and diversion system for this project shall be designed by a registered professional engineer with at least 5 years of experience in this type of work.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D421	(1985, R 2007) Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D422	(1963; R 2007) Standard Test Method for Particle-Size Analysis of Soils
ASTM D4767	(2011) Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Design Details - Diversion; G, DO

Complete construction drawings and detail drawings showing all aspects of the Muddy River control and diversion system for all work areas. For all pumps, details shall include manufacturer's information on pump performance curves, specifications, a control diagram, and written sequence of control for the pumping system.

Submit complete construction and detail drawings for all work areas of enclosed temporary cofferdam structure; width and shape of channel opening remaining to pass flows; number, sizes, and locations of pumps required to pass equivalent river capacity; number, sizes, and locations of pumps required to dewater within cofferdam; locations of outlets for pump dewatering discharge; and method of treatment of discharge water. Temporary cofferdam structures may include steel sheet piling, bladder dams, portadams (or equivalent) but may not include placement of fill.

Emergency Operations Plan; G, DO

A written plan detailing Contractor's actions to operate and maintain or remove the diversion system during flood events. For purposes of the Emergency Operations Plan, a triggering flood event is defined as a storm event that causes river levels to rise to an elevation of 3 feet NAVD88 upstream of the FRCS. The Contractor shall document the minimum water surface elevation that each temporary cofferdam can withstand without displacement or overtopping. The Contractor shall document their threshold elevation for removing each cofferdam along with the means and methods for removing each cofferdam to prevent displacement of each temporary cofferdam and unintentional obstructions of flow.

SD-05 Design Data

Calculations - Diversion Structures; G, DO

Detailed calculations shall be submitted for structural, geotechnical and hydraulic design aspects of the diversion system(s). Hydraulic calculations documenting calculation of the displaced flow and demonstrating that the proposed diversion system(s) will pass displaced flow without exceeding 6 inches of river level change upstream or downstream of diversions at all times including high water and floods. Pump selection justification including pump curves and head. Pipe calculations justifying selected pipe size and thickness. Structural and geotechnical calculations documenting design of temporary cofferdam system including earth supports, pipe supports, pipe restraints, and equipment supports.

SD-06 Test Reports

Subsurface Investigation of Diversion System; G, DO

A detailed subsurface investigation report shall be submitted detailing the existing soils types, water table location and soil

properties along the center line of the selected locations of the diversion structures and temporary cofferdams. See detail in Subpart 1.6.2 "Required Subsurface Investigations". Three copies of this subsurface report shall be submitted.

1.5 FLOW DATA

An active USGS gage exists on the left bank, 20 feet downstream from the Netherlands Road Bridge, near the Brookline Water Department building in Brookline, MA. Data may be useful for remotely monitoring changes in river stage and precipitation upstream of the project. Data for gage 01104683 (Muddy River at Brookline, MA) can be found at:

http://waterdata.usgs.gov/ma/nwis/uv/?site_no=01104683&PARAMeter_cd=00065,00060
The Contractor shall confirm the elevation of the gage.

1.5.1 General Hydrology and Hydraulics

The Muddy River loses 20 feet in elevation in approximately 500 feet of length between Jamaica Pond and Ward's Pond. From Ward's Pond, the river flows north as a small meandering stream to Willow Pond, a one-acre shallow pond. The drop is approximately 30 feet in a distance of approximately 1,400 feet. The outlet from Willow Pond is a culvert that surfaces just above Leverett Pond. The river drops approximately 9 feet in the 400-foot length between the ponds. Leverett Pond is a shallow (approximately 3 to 4 feet deep during dry weather conditions), oblong, 12.8-acre pond surrounded by grassed park land. Two moderately-sized drains contributing flow to the upper portion of the pond include Chestnut Street (which discharges to Willow Pond) and Daisy Field drains. The largest tributary of the river (3.65 sq. mi.), draining over half the area above the Riverway, is the Village Brook Drain. This drain enters Leverett Pond from the northwest just upstream of the pond's outlet.

From Leverett Pond, the Muddy River flows north under Route 9 and Brookline Avenue, continuing through park land and running parallel to the Riverway and MBTA green line until it reaches the Riverway near the Landmark Center (former Sears building). In this area, under normal flow conditions, the river is extremely shallow and slow-moving. In the upstream southern portion of this reach, the river is straight, 10 to 20 feet wide and 1 to 2 feet deep, with dense emergent vegetation on either bank. A moderately-sized drain, Huntington Avenue, discharges in this reach. In the downstream northern portion of this reach from Netherlands Road to the Riverway, the river broadens from approximately 50 to 150 feet wide, respectively. Tannery Brook and Longwood Avenue drains enter in this reach.

Riverway: Just before the Riverway, the Flow Restriction Control Structure (FRCS) was installed during Phase I to mimic the flow restriction of the former twin 72" culverts (see detailed description in section 1.7.1). At the Riverway, the river flows through a 10' by 24' culvert into a reach that was formerly a parking lot (construction was completed on the culvert and daylighting during Phase I, in 2016). The ends of two 6-foot diameter culverts remain in this reach at the entrance to the Brookline Avenue Gate House, which is a gated diversion structure. The gate house was originally installed to divert water directly to the Charles River through the Muddy River Conduit while limiting saltwater intrusion into the Riverway portion of the Muddy River when the lower Muddy River was a tidal estuary.

The purpose of the gated structure is to reduce flood flows in the Muddy River by diverting water into the Muddy River Conduit, which runs under

Brookline Avenue, continues under Kenmore Square to Deerfield Street, and eventually into the Charles River. In 1995, the Brookline Avenue Gate House was equipped with a 92" X 78" gate that could be closed during low and average flow conditions to divert all flows to the Fens for water quality enhancement. (Per Boston Water and Sewer Commission/BWSC this gate is currently maintained in the closed position and not actively used.)

Back Bay Fens: After the gated diversion structure, flow to the Back Bay Fens passes through a 10' by 24' culvert under Brookline Avenue installed in 2016. The Back Bay Fens stretch of the river is approximately 1.5 miles long and discharges to the Charles River just above the Massachusetts Avenue Bridge at the Charlesgate interchange. The Fens is what remains of the 750-acre Back Bay of the Charles River, which was filled in the mid-nineteenth century. The Muddy River enters the 9-mile-long Charles River Basin 2.2 miles upstream from the Charles River Dam. The Charles River Dam maintains the basin at a nearly constant level, as a result, during dry weather, the water level in the Fens also remains nearly constant.

Stony Brook Conduit: The Stony Brook Conduit collects flow from West Roxbury and Hyde Park and conveys it through Jamaica Plain into the Fenway area, where it discharges into the Charles River at the MWRA's Charlesgate Gate House located at the Charlesgate interchange of Storrow Drive. During times of significant wet weather, a combined sewage overflow from the Stony Brook Conduit can occur into the Muddy River at the Fens Pond at Boston Gate House No. 1 or at the MWRA's Fens gate house into the Charles River. Recent estimates indicate overflows occur at Gate House No. 1 approximately twice per year.

Charles River Basin: Flow within the Charles River Basin is generally eastward from the Watertown Dam, at river mile 9.8, through parts of Newton, Cambridge, and Boston to the Charles River Dam, Boston, at river mile 0.8. The current Charles River Dam was constructed in 1978 to provide dependable flood protection for low-lying urban areas adjacent to the basin during major coincident fresh-water and/or tidal events. Major flood control components of the dam are 6 flood control pumps that have a total capacity of 8,400 cfs when pumping against 9 feet of static head. In addition to this pumping capacity, the dam has two sluiceways and a boat lock system that can be operated at low tide to release significant flow by gravity drainage. With all components operating, total gravity outflow at mean low tide and normal basin level is about 11,000 cfs.

Operation of the Charles River Dam is critical to the design of the Muddy River Flood Damage Reduction Project. Normal Charles River basin elevation is 1.6 feet NAVD88, which controls the elevation of the Muddy River during times of low flow. Flood conditions occurring in the Charles River can cause this elevation to rise. For the Muddy River to convey the design flows without flood damages, the water level behind the Charles River Dam must be no higher than 2.1 feet, NAVD88. The pumps at the dam have the capacity to maintain this water level during the design flood even if it occurs at a high tide.

The following table presents estimated flow rates resulting from various rainfall events. Note that these are only estimates as the complex inter-relationship of rainfall, runoff and flow in an urban area will be dependent upon size and extent of intense rainfall, as well as season, antecedent flow conditions, and extenuating circumstances such as clogged storm drains in streets. These factors affect not only the Muddy River's drainage area, but also Stony Brook and the Charles River Basin and result

in a range of possible flow rates at each work area. The corresponding water surface elevation for each flow rate will depend on how much dredging and invasive species removal has been completed and will change throughout the duration of construction.

Precipitation and Flow Rates

<u>Estimated Event Frequency</u>	<u>Rainfall per 24 hours (inches)</u>	<u>Estimated Muddy River Flow Above Riverway (CFS)</u>	<u>Estimated Stony Brook Conduit Overflow (CFS)</u>
Average daily flow	None	6	None
More than 3x per year	0.5	50	60
Est. 3 times per year	0.6	60	80
Est. 2 times per year	0.75	75	100
More than once a year	1	100	130
Est. 1-year	2.8	275	350
Est. 2-year	3.3	330	420
Est. 10-year	4.8	450	570
Est. 20-year	7.9 ⁽¹⁾	1,100 ⁽²⁾	1,350

(1) This rainfall occurred during the October 1996 storm and is the design event for the Muddy River Flood Damage Reduction and Environmental Restoration Project.

(2) Note that flow through the temporary Flow Restriction Control Structure is limited to 450 cfs at elevation 9.0 feet NAVD88. The remaining flow goes out of banks into storage and might reenter the channel downstream, depending on flow rates and other factors such as barriers to flow.

1.6 GEOTECHNICAL DATA

1.6.1 Existing Geotechnical Information

For the purposes of preparing and submitting a proposal for this solicitation, the Offeror may use the existing boring data collected for Phase I to compare new data and check for reasonableness. The Phase I data is in: Borings FD-09-A to FD-09-D for the diversion system/flow restriction control structure design at the Riverway, Borings SPL-SB-7 and FD-05-F for the diversion system at the Upper Fens Pond, and Boring FD-05-L for the diversion system at Avenue Louis Pasteur. The boring logs are attached at the end of the specification document. The boring locations and profiles are shown on the contract drawings.

1.6.2 Required Subsurface Investigations

If the Muddy River project is to be built in the dry, some method of dewatering and water containment will be required. Cofferdams will likely be necessary between sections. No soil test borings have been conducted

for the anticipated cofferdams within the Muddy River Phase II sections. Before building a cofferdam, it is critical to know what soil conditions are expected.

For the proposed locations of all structures, the Contractor shall conduct a new subsurface investigation prior to design and selection of a system. A minimum of four soil test borings per section shall be required for all sections dewatered. Borings on the border of two adjacent sections may be counted for both sections. The test borings should be located within ten feet of the centerline and extend to the expected depth of the sheeting plus ten feet. Standard sampling should be conducted at five foot intervals below the depth that the sampler advances under the weight of the hammer and shall include, but not be limited to, soil testing to determine soil classifications with depth in accordance with [ASTM D2487](#), [ASTM D421](#), and [ASTM D422](#) (laboratory), and shear strength in accordance with [ASTM D4767](#). The results from these investigations shall be submitted in accordance with Subpart SUBMITTALS.

The Contractor shall be responsible for controlling all groundwater in the soil conditions encountered. If dewatering is selected, the adjacent building foundations shall be protected. Wells to monitor the groundwater level shall be installed at a minimum of one per section along the river between the cofferdam and the closest building wherever the closest foundation is within 200 feet of the dewatered section. Any additional borings that may be needed to identify soil conditions shall be the contractor's responsibility. The temporary installation and removal of cofferdams shall be the contractor's responsibility. See Section [33 01 00](#) GEOTECHNICAL INSTRUMENTATION AND MONITORING for specific requirements.

1.7 WATER CONTROL SYSTEM REQUIREMENTS

1.7.1 Existing Flow Restriction Control Structure

The Muddy River Flow Restriction Control Structure (FRCS) is designed to pass all flows up to a maximum of 450 cfs. Normal flow above The Riverway is estimated to be 6 cubic feet per second (cfs). The system is designed to maintain river surface elevation within plus or minus 6 inches of normal water level when passing normal flow. The system is designed to pass up to 450 CFS without exceeding a river surface elevation of 9 feet NAVD88 upstream of the Riverway conduit entrance, and also not exceeding 8 feet NAVD88 downstream of the Avenue Louis Pasteur culvert.

The FRCS has a top elevation of 9 feet and is equipped with stoplogs that are set to elevations 0.4 feet NAVD88 on the right and 6.6 feet NAVD88 on the left. These are to remain in place for the duration of phase II to restrict flow to approximately the capacity of the former twin 72-inch culverts at the Riverway. Maintenance of the FRCS and removal at the completion of construction is the responsibility of the Contractor from the receipt of the Notice to Proceed.

1.7.2 Cofferdam Systems

Temporary cofferdam systems shall be used to channelize the water through the construction area or to block flow entirely. Channels through the project should be of sufficient width and depth to safely handle the river flows as defined above. Temporary cofferdam structures may include steel sheet piling, bladder dams, portadams (or equivalent) but may not include placement of fills. Open channels may need to be protected to prevent bank erosion. Outboard toe scour protection will also need to be provided. A

pumping system will need to be put into place to handle leakage through and seepage under the temporary cofferdams as well as rainfall into the construction site. The water pumped from this system shall be treated before it is released back into the river or downstream. See Section 01 57 20 ENVIRONMENTAL PROTECTION, Subpart "Waste Water Discharge Standards" for specific discharge requirements. The design details for these walls shall be submitted in accordance with Subpart SUBMITTALS. The top elevations of the cofferdams shall be established by the Contractor as necessary to not displace more flow than can be compensated for with pumping capacity provided to pass flow displaced by the cofferdam. See Table in Subpart "General Hydrology and Hydraulics" for known historical frequency of flows and corresponding flow rates. Determination of the top elevation of each localized cofferdam is the responsibility of the Contractor and any and all damage to constructed work and the repair and/or replacement of such constructed work is the responsibility of the Contractor at no cost to the Government. Additionally, induced flooding damage to the upstream and downstream work areas and communities resulting from inadequate water control is the responsibility of the Contractor.

The Contractor shall ensure that the temporary cofferdam does not become displaced from its installation location and otherwise obstruct flow. The Contractor may elect to remove the temporary cofferdam in advance of high water or flooding to prevent movement of the structure and unintentional obstruction of flow.

1.7.3 Pumped Diversion System

Any pumped diversion system shall use multiple pumps of varying capacity to provide smooth flow transitions over the design flow range. Sufficient redundancy shall be provided such that the maximum design flow can be accommodated if any one of the pumps fails to operate. The smallest pump shall be sized to pump at least 20 cfs and shall be provided with both an electric driver for normal operation and a backup diesel driver. All other pumps shall be provided with diesel drivers. Diesel drivers shall have critical grade silencers (see Section 01 57 20 ENVIRONMENTAL PROTECTION for noise restriction). Pumps shall have variable speed drives and shall be controlled by an automatic system which varies the pump speed and brings additional pumps on line in response to a level control to a change in the river level. There shall be a manual override switch which will disable the automatic controls and allow manual operation of each pump. The control system shall be provided with 48 hour battery back-up, and shall include an alarm with modem which can be programmed to call five telephone numbers. System shall alarm if any one of the pumps fails to start on signal, and/or if intake sump water level rises above or falls below high and low set points (set points to be determined in field). Intake sumps shall be designed and constructed in accordance with the pump manufacturer's recommendations with regard to minimum submergence, intake water velocity, pump spacing and location within the sump, and sump lining materials. Discharge piping shall meet requirements of gravity system above. Provisions shall be made to minimize erosion at the discharge end of the piping.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 PUMPED DIVERSION SYSTEM

The contract drawings show concept plans for a multi-phased water diversion

scheme. These are concept plans only, no details are provided and no supporting calculations were done. The Contractor may use these concept plans as the beginning basis for developing a diversion design, or the Contractor may develop and design a completely different diversion plan which meets all the requirements of the plans and specifications.

The concept water diversion schemes shown on the contract drawings provide for construction of sheet pile cofferdams and pumps to divert the Muddy River from upstream of each work area to an outlet downstream of each work area to allow for in-the-dry removal of river sediment. If the Contractor chooses to use cofferdam structures, he must coordinate the cofferdam design and pump system design such that flood water levels upstream and downstream of such systems are not adversely affected.

3.2 DEWATERING

The areas within the cofferdams and all excavation areas therein shall be dewatered and maintained in a dry condition to the extent required to construct the work in accordance with all applicable provisions in other sections of the specifications.

3.3 EMERGENCY BREACHING AND REMOVAL OF COFFERDAMS

Removal of the temporary cofferdams in advance of high water or flood events is at the discretion of the Contractor. If the structural integrity of the cofferdam does become critical, or there is a potential for displacement of the temporary cofferdam and unintentional obstructions to flow, then breaching or removal of the temporary cofferdam shall be performed at no expense to the Government.

3.4 FLOW RESTRICTION CONTROL STRUCTURE (FRCS)

The Contractor shall not allow flows to pass unrestricted through the newly constructed culverts or channels. Prior to allowing water to flow through the new culverts and channels, the Contractor shall maintain the FRCS upstream of the Riverway culvert to convey all flows from the flow conditions up to 450 cfs without the water surface elevation exceeding elevation 9.0 ft NAVD88. This includes removal of debris and maintenance of the sheet piles and stoplogs such that their top elevations are not significantly increased by debris buildup or decreased by damage and the FRCS functions as designed.

3.5 LOCATION OF FRCS - MWRA RIGHT-OF-WAY

The location of the FRCS is upstream of the Riverway Culvert. The location of the FRCS is shown on the contract drawings. Maintenance and removal equipment shall be located so as not to encroach within the Massachusetts Water Resources Authority (MWRA) sewer main right-of-way. Any encroachment within the MWRA right-of-way will require that the Contractor obtain a permit from the MWRA. The Contractor shall not allow any equipment or materials within the MWRA right-of-way. The Contractor shall construct a construction fence along the edge of the right-of-way adjacent to the Contractor's work area to prevent any accidental encroachment of materials and equipment into the right-of-way. The right-of-way extends 25 feet downstream from the centerline of the 66-inch diameter sewer main. The Contractor shall coordinate with the MWRA for the precise location of the sewer main and limit of the right-of-way.

3.6 SCOUR PROTECTION

The Contractor shall design scour protection upstream and downstream of all diversion and control structures to prevent erosion under all potential flow conditions, including overtopping to the structure, from scouring the riverbed on either side of the structure and destabilizing the structure.

3.7 OPERATION AND MAINTENANCE

The Contractor shall provide sufficient personnel, materials and equipment to operate and maintain the diversion system at all times, especially during flood events. The Contractor shall have adequate personnel on call to perform emergency flood operations in accordance with the approved Emergency Operations Plan, 24 hours a day 7 days a week for as long as the diversion system is in use.

3.7.1 Cofferdams and Diversion Channels

The Contractor shall continuously monitor all cofferdams for evidence of movement, erosion, deterioration, and excessive seepage throughout their use. The cofferdams and diversion channels shall be maintained in good working order as directed and as necessary for the safety of workmen and the protection of the permanent work.

3.7.2 Piped Gravity Diversion Systems

The Contractor shall continuously monitor all piping systems for evidence of pipe displacement or leakage. The piping system(s) shall be maintained in good working order as directed and as necessary for the safety of workmen and the protection of construction areas and the permanent work. Cofferdams shall be monitored as above.

3.7.3 Pumped Diversion Systems

The Contractor shall be responsible for continuous monitoring, operation, and maintenance of the pumped diversion system. This includes monitoring of automatic pump operation during normal flows, and assuming manual control of pump operation during high flows. All equipment (whether operating or not) shall be checked daily to make sure it is in good condition and ready to run. Diesel pump drivers shall be test operated on a weekly basis to ensure they will function if required. Cofferdams and discharge piping shall be monitored as above.

3.7.4 Trash and Debris Removal

The Contractor will be responsible for trash and debris trapped upstream of, or on/within, the Contractor's cofferdam structures for the duration of these structures. The Contractor shall remove trapped trash and debris on a weekly basis, or more frequently as necessary, from these structures or after any event with greater than one inch of rainfall.

3.8 OPERATION OF FLOW RESTRICTION CONTROL STRUCTURE

The Contractor will be responsible for trash and debris trapped upstream of, or on/in the Flow Restriction Control Structure for the duration of Phase II. The Contractor shall remove trapped trash and debris on a weekly basis, or more frequently as necessary, or after any event with greater than one inch of rainfall.

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The Contractor will be responsible for providing maintenance and/or repairs as necessary to keep the Flow Restriction Control Structure functioning with the weirs at 0.4 feet NAVD88 and 6.6 feet NAVD88 and the top elevation at 9.0 feet NAVD88. The Contractor will be responsible for providing, locating, and operating equipment whenever directed by the Contracting Officer for the purpose of opening the stoplogs as determined necessary for maintenance.

-- End of Section --

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- 1.3 PROTECTION OF EXISTING HISTORIC PROPERTIES
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SECTION 02 42 91

HISTORIC, ARCHAEOLOGICAL AND CULTURAL RESOURCES

PART 1 GENERAL

1.1 GENERAL

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this subpart include but are not limited to: all human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities.

Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

The Boston City Archaeologist shall be notified when a specific site is identified or uncovered. The Boston City Archaeologist, Mr. Joseph Bagley, can be reached by email at "joseph.bagley@boston.gov", or by cell phone at 617-869-6451.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. DEPARTMENT OF THE INTERIOR

Cultural Landscapes

(1996) Secretary of the Interior's
Guidelines for the Treatment of Cultural
Landscapes

1.3 PROTECTION OF EXISTING HISTORIC PROPERTIES

Prior to any construction activities, the Contractor shall survey the site and examine the contract drawings and specifications to determine the extent of work. The Contractor shall take necessary precautions to avoid damage to existing historic properties within the work area listed in Subpart PREVIOUSLY IDENTIFIED HISTORIC PROPERTIES .

1.4 PREVIOUSLY IDENTIFIED HISTORIC PROPERTIES

The Massachusetts Historical Commission indicated that numerous individual properties and districts on the National Register of Historic Places exist within or near the project area.

Historic Districts

Olmsted Park System (aka Emerald Necklace Parks), National Register
Historic District and Boston Landmark (Boston and Brookline)
Brookline Multiple Resource Area
Metropolitan Boston Water Supply System Thematic Resource Area
Brookline Village Historic District - adjacent to Leverett Pond
Pill Hill Historic District (Brookline)- adjacent to Leverett Pond
Longwood Historic District (Brookline) - adjacent to Riverway

Historic Properties

Frederick Law Olmsted House, Brookline
George R. Minot House, Brookline

One known Native American archaeological site (19-SU-86-Olmsted Park) is recorded within State site files for the project area (eastern shore of Leverett Pond).

Historic properties within or immediately adjacent to or within the viewshed of the Phase 2 project area are listed below.

Work Area 1 - Leverett Pond

Olmsted Park - Cove Bridge at Leverett Pond, 1892-1894 (BOS.9301)
Leverett Pond - Pond Street, Boston and Huntington Ave., Brookline, 1881 (BOS.9298)
Leverett Pond Footbridge, Huntington Avenue, Brookline, 1894 (BKL.922)
Olmsted Park - Retaining Walls along Jamaica Way (BOS.9310)
19-SU-86 (Olmsted Park), Native American archaeological site.

Work Area 2/3 - Riverway

Riverway - Brookline Avenue Bridge, Boston, 1894 (BOS.9293)

Work Area 3/4 - Riverway

Netherlands Road Bridge, 1894 (BOS.9292)

Work Area 4/5/6 - Riverway

Riverway Pathway (BOS.9617)

Work Area 5 - Riverway

Riverway Shelter/Toolhouse, Park Drive, 1893 (BOS.9288)
Chapel Street Bridge, Park Drive, 1890 (BOS.9289)
Bridle Path Bridge, Park Drive, 1892-1893 (BOS.9290)
Carlton Street Footbridge, Carlton Street, Brookline, 1894

Work Area 6 - Riverway

Riverway Administration Building, 440 Park Drive, 1894-1895 (BOS.7536)

Work Area 7/8 - Back Bay Fens

Clemente, Roberto Field (BOS.9286)

Work Area 9/10 - Back Bay Fens

Back Bay Fens World War II Memorial, Park Drive, 1948 (BOS.9275)
Back Bay Fens Rose Garden, Park Drive, 1924 (BOS.9278)

Work Area 10/11 - Back Bay Fens

Agassiz Road Bridge, 1888 (BOS.9279)
Agassiz Road Gate House ("Duck House") (BOS.7710)

Work Area 10 - Back Bay Fens

Stony Brook Gate House #1 (1880) and #2 (1905) (BOS.7287 and 7288)

Work Area 11/12 - Back Bay Fens

Boston Fire Alarm Headquarters Building, 1925 (BOS.7286)

Work Area 12 - Back Bay Fens

Back Bay Fens Victory Garden, Park Drive, 1940 (BOS.9276)

Boylston Street Bridge, Boston, 1880 (BOS.9273)

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 SITE WORK

Site work within the Olmsted Park System shall be conducted in accordance with the Guidelines for the Treatment of Cultural Landscapes including, but not limited to, plantings, grading, pathways and excavation.

-- End of Section --

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SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance with ACI 318.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2010; ERTA 2015) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2010) Guide to Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016) Building Code Requirements for Structural Concrete and Commentary
ACI 347	(2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2016b) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C143/C143M	(2015a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2016) Standard Specification for Portland Cement
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2015a; E 2016) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2016) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2016b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2015a) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2014) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2016a) Standard Specification for Ready-Mixed Concrete
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
ASTM E1155	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1155M	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E1643	(2011) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2011) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Mock-Up Panel Written Notification; G, RO

SD-02 Shop Drawings

Installation Drawings; G, RO

SD-03 Product Data

Air-Entraining Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Expansion Joint Filler Strips, Premolded
Joint Sealants - Field Molded Sealants
Conveying and Placing Concrete
Formwork

Mix Design Data; G, RO
Ready-Mix Concrete
Curing Compound
Mechanical Reinforcing Bar Connectors

SD-04 Samples

Mock-Up Panel; G, RO

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions; G, RO
Compressive Strength Testing; G, RO
Slump; G, RO
Air Content
Water

SD-07 Certificates

Cementitious Materials
Pozzolan
CPG for recycled materials or appropriate Waiver Form
Aggregates
Delivery Tickets

SD-08 Manufacturer's Instructions

Curing Compound

1.4 QUALITY ASSURANCE

Indicate specific locations of concrete placement, forms, steel reinforcement, accessories, expansion joints, and contraction joints on [installation drawings](#) and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

1.4.1 Flatness and Levelness of Floor Slabs

Conduct floor flatness and levelness test, (FF and FL respectively), on floor slabs in accordance with the provisions set forth in [ASTM E1155M](#) or [ASTM E1155](#). Make floor tolerance measurements by the approved laboratory and inspection service within 24 hours after completion of final troweling operation and before forms and shores have been removed. Provide results of floor tolerance tests, including formal notice of acceptance or rejection of the work, to the Contracting Officer within 24 hours after data collection.

1.5 QUALITY ASSURANCE - ARCHITECTURAL CONCRETE FINISH

This subpart covers the requirements for the architectural concrete finish for the Boston Fire Alarm Headquarters floodwall.

1.5.1 Mock-Up Panels

1.5.1.1 Mock-Up Panel Location

The location of the architectural finished concrete shall be along the full

length of the floodwall along the entire visible surface of the outside and inside faces.

1.5.1.2 Mock-Up Panel Demonstration

Submit [mock-up panel written notification](#) to the Contracting Officer of the type of architectural concrete finish proposed. The architectural finish shall resemble the exterior surface of the Boston Fire Alarm Headquarters building. Examples of exterior finish panels can be seen here:

<https://customrock.com/pattern-type/texture/>

After the Contracting Officer has approved the type of architectural concrete finish and prior to starting construction of the floodwall, construct a [mock-up panel](#) of minimum size 8 feet long by 4 feet high.

The Contracting Officer shall determine if the mock-up panel resembles the appearance of the exterior surface of the Boston Fire Alarm Headquarters building. The construction of the floodwall and/or architectural finish shall not begin until written approval from the Contracting Officer.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The Government retains the option to sample and test joint sealer, joint filler material, aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with [ASTM D75/D75M](#). Sample concrete in accordance with [ASTM C172/C172M](#). Determine slump and air content in accordance with [ASTM C143/C143M](#) and [ASTM C231/C231M](#), respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with [ASTM C31/C31M](#). Test compression test specimens in accordance with [ASTM C39/C39M](#). Take samples for strength tests not less than once each shift in which concrete is produced from each strength of concrete required. Provide a minimum of five specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) for acceptance, two will be tested at 7 days for information and one held in reserve.

2.1.1 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, but not more than 20 percent, and no individual acceptance test result falls below f'c by more than 500 psi.

2.1.2 Construction Tolerances

Apply a Class "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in [ACI 117](#).

2.1.3 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions must include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. The specified compressive strength f'_c is 4,000 psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate is 3/4 inch, in accordance with [ACI 304R](#). The air content must be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water-cementitious material ratio is 0.50. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

2.2 MATERIALS

Submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the specified materials.

2.2.1 Cementitious Materials

Submit Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with [40 CFR 247](#). Provide cementitious materials that conform to the appropriate specifications listed:

2.2.1.1 Portland Cement

[ASTM C150/C150M](#), Type II, with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na₂O_e (sodium oxide) equivalent.

2.2.1.2 Pozzolan

Provide pozzolan that conforms to [ASTM C618](#), Class F, including requirements of Tables 1A and 2A.

2.2.2 Aggregates

For fine and coarse aggregates meet the quality and grading requirements of [ASTM C33/C33M](#). Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

2.2.3 Admixtures

Provide admixtures, when required or approved, in compliance with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

2.2.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of [ASTM C260/C260M](#).

2.2.3.2 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of [ASTM C494/C494M](#), Type A, B, or D. High-range water reducing admixture Type F or G may be used only when approved, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

2.2.4 Water

Mixing and curing water in compliance with the requirements of [ASTM C1602/C1602M](#); free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with [ASTM C1602/C1602M](#).

2.2.5 Reinforcing Steel

Provide reinforcing bars conforming to the requirements of [ASTM A615/A615M](#), Grade 60, deformed. Provide welded steel wire reinforcement conforming to the requirements of [ASTM A1064/A1064M](#). Detail reinforcement not indicated in accordance with [ACI 301](#) and [ACI SP-66](#). Provide [mechanical reinforcing bar connectors](#) in accordance with [ACI 301](#) and provide 125 percent minimum yield strength of the reinforcement bar.

2.2.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded of sponge rubber conforming to [ASTM D1752](#), Type I.

2.2.7 Joint Sealants - Field Molded Sealants

Conform to [ASTM C920](#), Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.2.8 Formwork

Design and engineer the formwork as well as its construction in accordance with [ACI 301](#) Section 2 and 5 and [ACI 347](#). Fabricate of wood, steel, or other approved material. Submit formwork design prior to the first concrete placement.

Formwork shall be altered with form liners and/or related items to create the architectural finish for the concrete flood wall as shown on the contract drawings.

2.2.9 Form Coatings

Provide form coating in accordance with [ACI 301](#).

2.2.10 Vapor Retarder and Vapor Barrier

ASTM E1745 Class C polyethylene sheeting, minimum 10 mil thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.2.11 Curing Materials

Provide curing materials in accordance with ACI 301, Section 5.

2.3 READY-MIX CONCRETE

Provide ready-mix concrete with mix design data conforming to ACI 301 Part 2. Submit delivery tickets in accordance with ASTM C94/C94M for each ready-mix concrete delivery, include the following additional information:

- a. Type and brand cement
- b. Cement content in 94-pound bags per cubic yard of concrete
- c. Maximum size of aggregate
- d. Amount and brand name of admixture
- e. Total water content expressed by water cementitious material ratio

2.4 ACCESSORIES

2.4.1 Curing Compound

Provide curing compound conforming to ASTM C309. Submit manufactures instructions for placing curing compound.

PART 3 EXECUTION

3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface must be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Satisfactorily compact earth foundations. Make spare vibrators available. Placement cannot begin until the entire preparation has been accepted by the Government.

3.1.1 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Prepare embedded items so they are free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. Provide all equipment needed to place,

consolidate, protect, and cure the concrete at the placement site and in good operating condition.

3.1.2 Formwork Installation

Forms must be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges , unless otherwise indicated.

3.1.3 Vapor Retarder and Vapor Barrier Installation

Install in accordance with [ASTM E1643](#). Apply vapor retarder and barrier over gravel fill. Lap edges not less than 12 inches. Seal all joints with pressure-sensitive adhesive not less than 2 inches wide. Protect the vapor barrier at all times to prevent injury or displacement prior to and during concrete placement.

3.1.4 Production of Concrete

3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to [ASTM C94/C94M](#) except as otherwise specified.

3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Conform to [ASTM C685/C685M](#).

3.2 [CONVEYING AND PLACING CONCRETE](#)

Convey and place concrete in accordance with [ACI 301](#), Section 5.

3.2.1 Cold-Weather Requirements

Place concrete in cold weather in accordance with [ACI 306R](#)

3.2.2 Hot-Weather Requirements

Place concrete in hot weather in accordance with [ACI 305R](#)

3.3 FINISHING

3.3.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

3.3.2 Finishing Formed Surfaces

Remove all fins and loose materials , and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Ream or chip surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete and fill with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. Use a blend of portland cement and white cement in mortar or concrete for repairs to all surfaces permanently exposed to

view shall be so that the final color when cured is the same as adjacent concrete.

3.3.3 Finishing Unformed Surfaces

Finish unformed surfaces in accordance with ACI 301, Section 5. Top of footing shall have a trowel finish.

3.3.3.1 Expansion and Contraction Joints

Make expansion and contraction joints in accordance with the details shown on the contract drawings or as otherwise specified. Provide 1/2 inch thick expansion joints at a maximum spacing of 120 feet on center, unless otherwise indicated. Provide contraction joints at a maximum spacing of 30 feet on center, unless otherwise indicated. Cut contraction joints at a minimum of one inch deep with a jointing tool after the surface has been finished.

3.4 CURING AND PROTECTION

Cure and protect in accordance with ACI 301, Section 5.

3.5 FORM WORK

Provide form work in accordance with ACI 301, Section 2 and Section 5.

3.5.1 Removal of Forms

Remove forms in accordance with ACI 301, Section 2.

3.6 STEEL REINFORCING

Reinforcement must be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.6.1 Fabrication

Shop fabricate steel reinforcement in accordance with ACI 318 and ACI SP-66. Provide shop details and bending in accordance with ACI 318 and ACI SP-66.

3.6.2 Splicing

Perform splices in accordance with ACI 318 and ACI SP-66.

3.6.3 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.7 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.8 TESTING AND INSPECTING

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within three days after the end of each weekly reporting period. See Section 01 45 00 QUALITY CONTROL.

3.8.1 Field Testing Technicians

The individuals who sample and test concrete must have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.8.2 Preparations for Placing

Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement to certify that it is ready to receive concrete.

3.8.3 Sampling and Testing

- a. Obtain samples and test concrete for quality control during placement. Sample fresh concrete for testing in accordance with ASTM C172/C172M. Make six test cylinders.
- b. Test concrete for compressive strength at 7 and 28 days for each design mix and for every 100 cubic yards of concrete. Test two cylinders at 7 days; two cylinders at 28 days; and hold two cylinders in reserve. Conform test specimens to ASTM C31/C31M. Perform compressive strength testing conforming to ASTM C39/C39M.
- c. Test slump at the site of discharge for each design mix in accordance with ASTM C143/C143M. Check slump once during each shift that concrete is produced for each strength of concrete required.
- d. Test air content for air-entrained concrete in accordance with ASTM C231/C231M. Test concrete using lightweight or extremely porous aggregates in accordance with ASTM C173/C173M. Check air content at least once during each shift that concrete is placed for each strength of concrete required.
- e. Determine temperature of concrete at time of placement in accordance with ASTM C1064/C1064M. Check concrete temperature at least once during each shift that concrete is placed for each strength of concrete required.

3.8.4 Action Required

3.8.4.1 Placing

Do not begin placement until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Discontinue placing if any lift is inadequately consolidated.

3.8.4.2 Air Content

Whenever an air content test result is outside the specification limits,

adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3.8.4.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. Make the adjustments so that the water-cementitious material ratio does not exceed that specified in the submitted concrete mixture proportion and the required concrete strength is still met.

-- End of Section --

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PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

- | | |
|-----------|---|
| ACI 211.1 | (1991; R 2009) Standard Practice for
Selecting Proportions for Normal,
Heavyweight and Mass Concrete |
| ACI 211.2 | (1998; R 2004) Standard Practice for
Selecting Proportions for Structural
Lightweight Concrete |
| ACI 305R | (2010) Guide to Hot Weather Concreting |
| ACI 306.1 | (1990; R 2002) Standard Specification for
Cold Weather Concreting |
| ACI 318 | (2014; Errata 1-2 2014; Errata 3-5 2015;
Errata 6 2016) Building Code Requirements
for Structural Concrete and Commentary |

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

- | | |
|-------------|---|
| ACPA 01-102 | (2000) Concrete Pipe Handbook |
| ACPA QPC | (202016) QCast Plant Certification Manual |

AMERICAN WELDING SOCIETY (AWS)

- | | |
|----------------|---|
| AWS D1.1/D1.1M | (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code - Steel |
| AWS D1.4/D1.4M | (2011) Structural Welding Code -
Reinforcing Steel |

ASTM INTERNATIONAL (ASTM)

- | | |
|-------------------|---|
| ASTM A1064/A1064M | (2016b) Standard Specification for
Carbon-Steel Wire and Welded Wire
Reinforcement, Plain and Deformed, for
Concrete |
| ASTM A153/A153M | (2016) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware |

ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2016) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884/A884M	(2014) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1107/C1107M	(2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1244	(2011) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C138/C138M	(2016a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2015a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C1478	(2008; R 2013) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
ASTM C171	(2016) Standard Specification for Sheet Materials for Curing Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2016a) Standard Practice for Making and Curing Concrete Test Specimens in the

Laboratory

ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2015a; E 2016) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2016b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C857	(2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C858	(2010; E 2012) Standard Specification for Underground Precast Concrete Utility Structures
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C891	(2011) Installation of Underground Precast Concrete Utility Structures
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

CSA GROUP (CSA)

CSA A23.4	(2016; Errata 2016) Precast Concrete - Materials and Construction
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NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2012) Quality Control Manual for Precast and Prestressed Concrete Plants
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1.2 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

SD-02 Shop Drawings

Standard Precast Units; G, RO

Custom-Made Precast Units; G, RO

SD-03 Product Data

Standard Precast Units

Proprietary Precast Units

Embedded Items

Accessories

SD-05 Design Data

Design Calculations; G, RO

Concrete Mix Proportions

SD-06 Test Reports

Test Reports

SD-07 Certificates

Quality Control Procedures

SD-11 Closeout Submittals

Recycled Content for Fly Ash and Pozzolan

Recycled Content for Ground Iron Blast-Furnace Slag

Recycled Content for Silica Fume

Recycled Content for Synthetic Fiber Reinforcement

Recycled Content for steel

1.3 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in **NPCA QC Manual** or **ACPA QPC**. Meet requirements written in the subparagraphs below.

1.3.1 NPCA and ACPA Plant Certification

The precast concrete producer must be certified by the National Precast Concrete Association's or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.3.2 Qualifications, Quality Control and Inspection

1.3.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer must maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.3.2.2 Quality Control Procedures

Submit quality control procedures established by the precast manufacturer in accordance with [NPCA QC Manual](#) and [ACPA QPC](#). Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

1.3.2.2.1 Slump

Perform a slump test for each 150 cubic yards of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with [ASTM C143/C143M](#).

1.3.2.2.2 Temperature

Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with [ASTM C1064/C1064M](#).

1.3.2.2.3 Compressive Strength

Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: [ASTM C31/C31M](#), [ASTM C192/C192M](#), [ASTM C39/C39M](#).

1.3.2.2.4 Air Content

Perform tests for air content on air-entrained, wet-cast concrete for each 150 cubic yards of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either [ASTM C231/C231M](#) or [ASTM C173/C173M](#) for normal weight aggregates and [ASTM C173/C173M](#) for lightweight aggregates.

1.3.2.2.5 Unit Weight

Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cubic yards of lightweight concrete in accordance with [ASTM C138/C138M](#).

1.3.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.3.2.4 Test Reports

Submit the following:

1.3.2.4.1 Material Certifications or Laboratory Test Reports

Include mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

1.3.2.4.2 Mix Test

Submit reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

1.3.2.4.3 Self-Consolidating Concrete

Submit sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

1.3.2.4.4 In-Plant QA/QC Inspection Reports

Submit inspection reports upon the request of the Contracting Officer.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.4.2 Storage

Store units off the ground or in a manner that minimizes potential damage.

1.4.3 Handling

Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes must be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least three years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades. Below grade structures must comply with [ASTM C858](#).

2.1.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards [ACI 318](#), [ASTM C857](#) and [ACPA 01-102](#), Chapter 7-Design for Sulfide Control. Design must also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings. Submit drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings must demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings. Submit cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

2.1.2 Custom-Made Precast Units

Submit [design calculations](#) for custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices. Submit drawings furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

2.1.3 Proprietary Precast Units

Products manufactured under franchise arrangements must conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, must conform to the requirements in this specification. Submit standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

2.1.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and

configuration indicated on shop drawings meeting specified design and performance requirements.

2.1.5 Concrete Mix Design

2.1.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in [ACI 211.1](#) for normal weight concrete and [ACI 211.2](#) for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design and proportions for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

2.1.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'_c) of 4,000 psi. Custom-made precast concrete units shall have a 28-day compressive strength (f'_c) of 5,000 psi.

2.1.5.3 Water-to-Cement Ratio

Where exposed to freezing and thawing, furnish concrete containing entrained air and with a water-cementitious ratio of 0.45 or less. Where not exposed to freezing, but required to have a low permeability, furnish concrete with a water-cementitious ratio of 0.48 or less. Where exposed to deicer salts, brackish water, or seawater, furnish concrete with a water-cementitious ratio of 0.40 or less, for corrosion protection.

2.1.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions must be within the limits given below.

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT PERCENT	
	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
3/8 inch	6.0	7.5
1/2 inch	5.5	7.0
3/4 inch	5.0	6.0
1.0 inch	4.5	6.0

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT PERCENT	
	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
1.5 inch	4.5	5.5
Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent		

2.2 MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS:

- a. Recycled content for fly ash and pozzolan
- b. Recycled content for Ground Iron Blast-Furnace Slag
- c. Recycled content for Silica Fume
- d. Recycled content for Synthetic Fiber Reinforcement
- e. Recycled content for steel, 75 percent minimum

2.2.2 Pigments

Non-fading and lime-resistant

2.2.3 Reinforcement

2.2.3.1 Reinforcing Bars

- a. Deformed Billet-steel: ASTM A615/A615M
- b. Deformed Low-alloy steel: ASTM A706/A706M

2.2.3.2 Reinforcing Wire

- a. Plain Wire: ASTM A1064/A1064M
- b. Deformed Wire: ASTM A1064/A1064M

2.2.3.3 Welded Wire Reinforcement

- a. Plain Wire: ASTM A1064/A1064M
- b. Deformed Wire: ASTM A1064/A1064M

2.2.3.4 Epoxy Coated Reinforcement

- a. Reinforcing Bars: ASTM A775/A775M
- b. Wires and Welded Wire: ASTM A884/A884M

2.2.3.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to [ASTM A767/A767M](#).

2.2.4 Synthetic Fiber Reinforcement

Provide fiber reinforced concrete in accordance with [ASTM C1116/C1116M](#) Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be 100 percent virgin monofilament polypropylene fibers, with a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement.

2.2.5 Inserts and Embedded Metal

All items embedded in concrete must be of the type required for the intended task, and meet the following standards.

- a. Structural Steel Plates, Angles, etc.: [ASTM A36/A36M](#)
- b. Hot-dipped Galvanized: [ASTM A153/A153M](#)
- c. Proprietary Items: In accordance with manufacturers published literature

2.2.6 Accessories

Submit proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

- a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: [ASTM C443](#).
- b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: [ASTM C877](#).
- c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: [ASTM C990](#).
- d. Elastomeric Joint Sealants: [ASTM C920](#)

2.2.7 Pipe Entry Connectors

Pipe entry connectors must conform to [ASTM C923](#) or [ASTM C1478](#).

2.2.8 Grout

Nonshrink Grout must conform to [ASTM C1107/C1107M](#). Cementitious grout must be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with [NPCA QC Manual](#) or [ACPA QPC](#) unless

specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or [ACI 318](#) for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire reinforcement into rigid assemblies or by welding, where permissible, in accordance with [AWS D1.4/D1.4M](#). Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover must be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with [AWS D1.1/D1.1M](#) when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix at the batch plant in accordance with the applicable sections of [ASTM C1116/C1116M](#) and the recommendations of the manufacturer. Use a minimum of 1.5 pounds of fibers per cubic yard of concrete.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations must produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with [ACI 306.1](#).

- a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.
- b. All concrete materials, reinforcement, forms, fillers, and ground with which concrete is to come in contact must be free from frost.
- c. Do not use frozen materials or materials containing ice.
- d. In cold weather the temperature of concrete at the time of placing must not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Follow recommendations for hot weather concreting in [ACI 305R](#). During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing must not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

- a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with [ASTM C171](#).
- b. Cover with burlap or other absorptive material and keep continually moist.
- c. Use a membrane-curing compound, conforming to [ASTM C309](#) and applied at a rate not less than 200 square ft/gallon, or in accordance with manufacturers' recommendations.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with [CSA A23.4](#). If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete must not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted. Major imperfections, honeycombs, or other major defects are not permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes must be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes must be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair

procedure.

3.2.7 Shipping Products

Do not ship products until they are at least five days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

- a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.
- b. Lift products by suitable lifting devices at points provided by the precast concrete producer.
- c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with [ASTM C891](#). Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.
- d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use one of the following methods:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to [ASTM C1244](#).

3.4.3 Water Testing

Perform water testing according to the contract documents and precast concrete producer's recommendations.

-- End of Section --

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SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.
- c. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E2174	(2014b) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E84	(2016) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2015) Fire Tests of Through-Penetration Firestops
UL 723	(2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2014) Fire Resistance Directory

1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit, or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping System; G, RO

SD-03 Product Data

Firestopping Materials; G, RO

SD-06 Test Reports

Inspection; G, RO

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications; G, RO

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

- a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer [installer qualifications](#) on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 [FIRESTOPPING SYSTEM](#)

Submit detail drawings including manufacturer's descriptive data, typical details conforming to [UL Fire Resistance](#) or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 [FIRESTOPPING MATERIALS](#)

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products [FM APP GUIDE](#) approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with [ASTM E84](#) or [UL 723](#). Material shall be an approved firestopping material as listed in [UL Fire Resistance](#) or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems shall be **UL Fire Resistance** listed or **FM APP GUIDE** approved with "F" rating at least equal to fire-rating of fire wall in which penetrated openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with **ASTM E814** or **UL 1479**.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with **UL 1479**.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids **4 inches** or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade, as appropriate for the project:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions,

such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.3 INSPECTION

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. Inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.1 Inspection Standards

Inspect all firestopping in accordance to [ASTM E2393](#) and [ASTM E2174](#) for firestop inspection, and document inspection results to be submitted.

3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

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SECTION 22 13 29

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11 (2014) Load Ratings and Fatigue Life for Roller Bearings

ABMA 9 (2015) Load Ratings and Fatigue Life for Ball Bearings

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2012) Standard Specification for Gray Iron Castings

ASTM A532/A532M (2010; R 2014) Standard Specification for Abrasion-Resistant Cast Irons

ASTM C923 (2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4 (2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110/A21.10 (2012) Ductile-Iron and Gray-Iron Fittings for Water

AWWA C111/A21.11 (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151/A21.51 (2017) Ductile-Iron Pipe, Centrifugally Cast

AWWA C153/A21.53 (2011) Ductile-Iron Compact Fittings for Water Service

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2015) Standard for Industrial Control and Systems: General Requirements

NEMA MG 1

(2014) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2017) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G, DO

SD-03 Product Data

Materials and Equipment; G, DO

Spare Parts

Installation Instruction Manual

SD-06 Test Reports

Field Test Report; G, DO

Installation and Start-Up Engineer

Performance Test Reports

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G, RO

1.3 CONDITIONS OF SERVICE

The pumps will be used in a storm water pumping station associated with a low flood wall located near the Muddy River at the Boston Fire Alarm Headquarters. The primary purpose of the pumps is to pump interior drainage (storm runoff) into the river during flood events combined with rainfall. Under normal conditions, storm water from the Boston Fire Alarm Headquarters site is prevented from entering the pumping station. Occasionally, the flood wall will be overtopped and water will enter the pumping station. The pumps will be required to pump this flood water back into the river after storm tides have receded.

1.4 QUALITY ASSURANCE

1.4.1 Pump Supplier Qualifications

The pump manufacturer shall have overall responsibility to supply the pumping unit (submersible pump/motor, discharge elbow, cables, instrumentation and accessories) that meet the requirements of this specification. Thus, during start-up, installation, and performance evaluation, the pump manufacturer is the sole responsible party. The pump

manufacturer shall supply a list of installations at which pumps of his manufacture, and ones similar to those specified, have been operating for at least 5 years.

1.4.2 Installation and Start-up Engineer

Contractor shall provide the services of a competent installation engineer approved by the pump manufacturer who is knowledgeable and experienced with the installation and start-up procedures for submersible pumps and the associated equipment specified. The installation engineer shall be responsible for providing complete and correct direction during installation, initial starting, and subsequent operation of equipment until field tests are completed. The installation engineer shall initiate instructions for actions necessary for proper receipt, inspection, handling, uncrating, assembly, and testing of equipment. The installation engineer shall also keep a record of measurements taken during erection and shall furnish one copy to the Contracting Officer on request or on the completion of the installation of assembly or part. The installation engineer shall instruct the Contracting Officer or others as designated in the operation and maintenance features of the pump units. Submit the installation report.

1.4.3 Detail Drawings

Submit drawings of sufficient size to be easily read, within 90 days of Notice of Award. Dimensions shall be in English units. Furnish the following:

- a. Outline drawings of the pump showing dimensions and weight of the pump/motor.
- b. Drawings showing details and dimensions of pump mounting design and layout including any embedded items.
- c. Cross-sectional drawings of the pump, showing each component, and major or complicated sections of the pump in detail. On each drawing indicate an itemized list of components showing type, grade, class of material used, and make and model of the standard component used. Include detail and assembly drawings of entire pumping unit assembly.
- d. Provide drawings covering the installation that the Contractor intends to furnish to the erecting engineer.
- e. The capacity-head curve should also show efficiency, bhp, and NPSHR as a function of flow rate.
- f. Motor characteristic curves or tabulated data (test or calculated) should indicate the speed, power factor, efficiency, current, and kilowatt input, all plotted or tabulated against percent load as abscissas.
- g. Control system schematic and wiring diagram.
- h. Manufacturer's data on control equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants all equipment delivered

and placed in storage.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the related submittals, and not later than six months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.1 Nameplates

Provide each major item of equipment with the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.2 Equipment Guards

Enclose or guard belts, pulleys, chains, gears, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto.

2.1.3 Special Tools

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

2.1.4 Electric Motors

Pump motors shall be a NEMA B design and shall conform to NEMA MG 1.

2.1.5 Motor Controls

Controls shall conform to NEMA ICS 1.

2.1.6 Bolts, Nuts, Anchors, and Washers

Bolts, nuts, anchors, and washers shall be 316 stainless steel.

2.2 SUBMERSIBLE CENTRIFUGAL PUMPS

Submersible centrifugal pumps shall be non-clog centrifugal type wastewater pumps and shall be capable of withstanding submergence as required for the particular installation.

2.2.1 Pump Characteristics

Pump numbers 1-2 located in the Boston Fire Alarm Headquarters Pumping

Station shall have the following operating characteristics:

Pump Service	Storm Water Drainage
Design Operating Point	1240 gpm flow, 16 feet head, 58 percent efficiency
Maximum Operating Point	1300 gpm flow, 12 feet head, 50 percent efficiency
Impeller Type	non-clog, hardened alloy
Operating Speed	1740 rpm
Normal Depth of Submergence Maximum Depth of Submergence	2 feet 9 feet
Motor Type	Induction
Electrical Characteristics	208 volts ac, 3 phase, 60 Hz
Size	Within rated load driving pump at specified rpm
Pump Control	Automatic Level Control
Maximum NPSH Required at Maximum Operating Point	30 feet head

2.2.2 Pump Casing

Pump casings shall be constructed of grey cast iron, [ASTM A48/A48M](#), Class 35B, with smooth surfaces, and free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. The casing shall be capable of withstanding operating pressures 50 percent greater than the maximum operating pressures. The volute shall have smooth passages which provide unobstructed flow through the pump. Lifting handle shall be stainless steel.

2.2.3 Mating Surfaces

Mating surfaces where watertight seal is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between mating surfaces, resulting in proper compression of the O-rings without the requirement of specific torque limits.

2.2.4 Coatings

The pumps will be required to operate in brackish water. All metal surfaces coming into contact with the pumpage including the interior and exterior of the pump and discharge elbow, the impeller, and the exterior of the motor, shall be protected by a factory applied coating consisting of zinc rich primer and two coats of epoxy type finish paint. Parts made of stainless steel are not required to be painted. All exposed nuts and bolts shall be

Type 316 stainless steel. After assembly, the entire unit shall be spray coated with a final layer of oxane ester to seal all mating surfaces.

2.2.5 Impeller

Impellers shall be of cast iron alloy, [ASTM A532/A532M](#). The impeller shall be of non-clogging design to minimize clogging of solids, fibrous materials, heavy sludge, or other materials found in storm water. The impeller shall be statically, dynamically, and hydraulically balanced within the operating range and to the first critical speed at 150 percent of the maximum operating speed. The impeller shall be securely keyed to the shaft with a locking arrangement whereby the impeller cannot be loosened by torque from either forward or reverse direction.

2.2.6 Wearing Rings

Wearing rings, shall be renewable type and shall be provided on the impeller and casing and shall have wearing surfaces normal to the axis of rotation. Material for wear rings shall be standard of pump manufacturer. Wearing rings shall be designed for ease of maintenance and shall be adequately secured to prevent rotation.

2.2.7 Pump Shaft

The pump and motor shaft shall be a single unit. Shaft shall be of stainless steel and shall be of adequate size and strength to transmit the full driver horsepower with a liberal safety factor. The shaft shall be completely isolated from the pumped liquid.

2.2.8 Shaft Seals

A tandem mechanical shaft seal system consisting of two totally independent seal assemblies shall be provided. The seals shall operate in a refillable lubricant reservoir which lubricates the seal faces at a constant rate. The seal system shall not rely on the pumped media for lubrication. Seals shall be of tungsten carbide with each interface held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and they shall not depend on direction of rotation for sealing.

2.2.9 Bearings

Pump bearings shall be ball or roller type designed to handle all thrust loads in either direction. Bearings shall be permanently grease lubricated. Pumps depending only on hydraulic balance end thrust will not be acceptable. Bearings shall have an ABEMA L-10 life of 50,000 hours minimum, as specified in [ABMA 9](#) or [ABMA 11](#).

2.2.10 Motor

The motor and pump shall be designed and assembled by the same manufacturer. The pump motor shall have Class H insulation, NEMA B design, in accordance with [NEMA MG 1](#), and shall be watertight. The motor shall be explosion proof. The motor shall be either oil filled, air filled with a water jacket, or air filled with cooling fins which encircles the stator housing. The motor shall be designed for continuous duty handling pumped media of 104 degrees F and capable of no less than 308 evenly spaced starts per hour. The combined service factor shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor horsepower shall be adequate so that the pump is non-overloading throughout

the entire pump performance curve from shut-off through run-out condition.

2.2.11 Power Cable

The power cable shall comply with **NFPA 70**, Type SO, and shall be of standard construction for submersible pump applications. The power cable shall enter the pump through a heavy duty entry assembly provided with an internal grommet assembly to prevent leakage. The cable entry junction chamber and motor shall be separated by a terminal board which shall isolate the motor interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems are not acceptable.

2.2.12 Zinc Anodes

Zinc anodes shall be provided to be mounted on the exterior motor housing and on the hydraulic end of the pump close to the pump inlet. Anodes shall be sized by the pump manufacturer based on a 2-year anode life span, 100 cm resistivity and 0.5 percent salt content of the pumped liquid. Anodes shall be provided with fasteners and mounting instructions.

2.2.13 Rail Mounted Installation Systems

Rail mounted installation systems shall consist of guide rail mounting brackets, guide rails, a sliding bracket, and a discharge connection elbow. Guide rails and guide rail mounting brackets shall be of 316 stainless steel of the size and type standard with the manufacturer and shall not support any portion of the weight of the pump. The sliding guide bracket shall be an integral part of the pump unit.

2.2.13.1 Discharge Elbow

The discharge connection elbow shall be cast iron and shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection and service without entering the pump well. Sealing between the pump and the discharge elbow shall be accomplished by a machined metal to metal watertight contact.

2.2.13.2 Discharge Check Valve

Pump discharge check valves shall be elastomer/rubber duckbill type with flanged connection. Provide 316 stainless steel backup flange rings. Discharge check valves shall be installed as shown on the contract drawings. Check valves shall be model TF-1 Check Valve, as manufactured by Tideflex Technologies, Carnegie, Pennsylvania, telephone 412-279-0044, website <http://tideflex.com/tf/index.php>, or approved equal.

2.2.13.3 Lifting Chain

Lifting chain to raise and lower the pump through the limits indicated shall be provided. The chain shall be stainless steel and shall be capable of supporting the pump.

2.2.14 Resilient Connectors

Flexible, watertight connectors used for connecting pipe to inlets shall conform to **ASTM C923**.

2.3 PUMP CONTROLS

Pumps shall operate via the control system provided by Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and shall perform the sequence of control described on the contract drawings.

2.4 PIPING

a. Pipe and Fittings: Pipe, AWWA C151/A21.51, Class 52. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints. Provide mechanical joints where indicated.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

2.5 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, controls and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Motor starters shall be soft starter type. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices but not shown, shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 EQUIPMENT INSTALLATION

Submit Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the Drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

3.2.1 Pump Installation

Install pumping equipment and appurtenances in the position indicated and

in accordance with the manufacturer's written instructions. Provide all appurtenances required for a complete and operating pumping system, including such items as piping, conduit, valves, wall sleeves, wall pipes, concrete foundations, anchors, grouting, pumps, drivers, power supply, and controls. Install discharge check valves in accordance with the manufacturer's recommendations.

3.2.2 Concrete

Concrete shall conform to Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

3.3 FIELD PAINTING

Field painting required for ferrous surfaces not finished at the factory shall be in accordance with manufacturer's recommendations.

3.4 FIELD TESTING AND ADJUSTING EQUIPMENT

3.4.1 Operational Test

Prior to acceptance, an operational test of all pumps, drivers, and control systems shall be performed to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally, or otherwise defective; is in safe and satisfactory operating condition; and conforms with the specified operating characteristics. Prior to applying electrical power to any motor driven equipment, the drive train shall be rotated by hand to demonstrate free operation of all mechanical parts. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels, and power consumption.

3.4.2 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted.

3.4.3 Performance Test Reports

Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. In each test report indicate the final position of controls.

3.5 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. Training shall be provided for a total period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the [operating and maintenance manuals](#). Submit six copies of operation and six copies of maintenance manuals for the equipment furnished, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Include in the operation manuals the manufacturer's name, model number, parts list,

and brief description of all equipment and their basic operating features. Include pump capacity-head curves. List in the maintenance manuals routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Manuals shall be approved prior to the field training course.

-- End of Section --

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DIVISION 26 - ELECTRICAL

SECTION 26 00 00

BASIC ELECTRICAL MATERIALS AND METHODS

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 - 1.4.1 Shop Drawings (SD-02)
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- 1.5 QUALITY ASSURANCE
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SECTION 26 00 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2016) Standard Specification for
Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE C2 (2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2014) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017) National Electrical Code

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.3 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 120/208V, three phase, three wire, 60 Hz. Final connections to the power distribution system at the existing panelboard 'DP-ESSENTIAL' shall be made by the Contractor as directed by the Contracting Officer.

1.4 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.4.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.4.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, **0.125 inch** thick, black with white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be **one by 2.5 inches**. Lettering shall be a minimum of **0.25 inch** high normal block style.

1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to **IEEE C2**, **NFPA 70**, and requirements specified herein.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.2 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

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SECTION 26 05 19

INSULATED WIRE AND CABLE

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SECTION 26 05 19

INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1202 (2006; R 2012; CORR 1 2012)
Flame-Propagation Testing of Wire and Cable

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA T-30-520 (1986) Conducting Vertical Cable Tray
Flame Tests with Theoretical Heat Input
Rate of 70,000 B.T.U./Hour

ICEA S-58-679 (2014) Control, Instrumentation and
Thermocouple Extension Conductor
Identification

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659 (2014) Standard for Nonshielded Cables
Rated 2001-5000 Volts for use in the
Distribution of Electric Energy

NEMA WC 57 (2014) Standard for Control, Thermocouple
Extension, and Instrumentation Cables

NEMA WC 70 (2009) Power Cable Rated 2000 V or Less
for the Distribution of Electrical
Energy--S95-658

NEMA WC 74/ICEA S-93-639 (2012) 5-46 kV Shielded Power Cable for
Use in the Transmission and Distribution
of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1685 (2015) UL Standard for Safety
Vertical-Tray Fire-Propagation and
Smoke-Release Test for Electrical and
Optical-Fiber Cables

UL 2556

(2015) UL Standard for Safety Wire and
Cable Test Methods

UL 44

(2014; Reprint Feb 2015)
Thermoset-Insulated Wires and Cables

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wire and Cable

Conductors

Cable Manufacturing Data

SD-06 Test Reports

Test Report(s), Inspection Report(s), and Verification Report(s);
G, RO

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, must be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable must contain only one continuous cable without splices. Reels must remain the property of the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Rated Circuit Voltages

All power wire and cable must have minimum rated circuit voltages in accordance with NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Power wire and cable for circuit voltages rated 0-600 volts must be rated not less than 600 volts. Control wire and cable must have minimum rated circuit voltages in accordance with NEMA WC 57, but must be rated 600 volts if routed in raceway with other conductors that are rated 600 volts.

2.1.2 Conductors

2.1.2.1 Material for Conductors

Conductors must conform to all the applicable requirements of NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Copper conductors must be annealed copper material and they may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used."

2.1.2.2 Size

Minimum wire size must be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits.

2.1.2.3 Stranding

Conductor stranding classes cited herein must be as defined for control conductors in [NEMA WC 57](#) or as defined for 0-2,000 volts power conductors in [NEMA WC 70](#), as applicable. Lighting conductors No. 10 AWG and smaller must be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, must have Class H or K stranding. All other conductors must have Class B or C stranding, except that conductors as shown, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.2.4 Conductor Shielding

Use conductor shielding conforming to [NEMA WC 57](#) for control wire and cable as applicable.

2.1.2.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.3 Insulation

2.1.3.1 Insulation Material

Unless specified otherwise or required by [NFPA 70](#), wires in conduit, other than service entrance, must be 600-volt, Type XHHW conforming to [UL 44](#). Insulation for control wire and cable must meet the requirements of [NEMA WC 57](#). Insulation requirements for wire and cable rated less than 2,000 volts must meet the requirements of [NEMA WC 70](#).

2.1.3.2 Insulation Thickness

The insulation thickness for each conductor must be based on its rated circuit voltage.

2.1.3.2.1 Power Cables, 2,000 Volts and Below

The insulation thickness for single-conductor and multiple-conductor power cables rated 2,000 volts and below must be as required by [NEMA WC 70](#), as applicable. Some thicknesses of [NEMA WC 70](#) will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. [NEMA WC 70](#) ethylene-propylene rubber-insulated conductors must have a jacket.

2.1.3.2.2 Single-Conductor and Multiple-Conductor Control Cables

The insulation thickness of control conductor sizes 22 AWG to 10 AWG used for control and related purposes must be as required by [NEMA WC 57](#), as applicable. Control conductors larger than 10 AWG must be as required by

NEMA WC 70.

2.1.4 Jackets

All cables must have jackets meeting the requirements of NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639, as applicable, and as specified herein. Individual conductors of multiple-conductor cables must be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, must be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables must be provided with a common overall jacket, which must be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.4.1 Jacket Material

The jacket must be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

2.1.4.1.1 General Use

Heavy-duty black neoprene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Heavy-duty chlorosulfonated polyethylene	NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Heavy-duty cross-linked (thermoset) chlorinated polyethylene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639

2.1.4.1.2 Accessible Use Only, 2,000 Volts or Less

Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, must have jackets of one of the materials in item "a. General Use" or one of the following:

General-purpose neoprene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
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Black polyethylene (MDPE)	NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Thermoplastic chlorinated polyethylene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639

2.1.4.2 Jacket Thickness

The minimum thickness of the jackets must be not less than 80 percent of the respective nominal thicknesses specified below.

2.1.4.2.1 Single-Conductor Cables

Single-conductor cables must have a jacket thickness as specified in NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables must be color-coded in accordance with ICEA S-58-679, except that colored braids will not be permitted. Only one color-code method must be used for each cable construction type. Control cable color-coding must be as indicated. Power cable color-coding must be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included. Other individual conductors must be color-coded as indicated, but such color-coding may be accomplished by applying colored plastic tapes or colored sleeves at terminations.

2.2.2 Cabling

Individual conductors of multiple-conductor cables must be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639. Flat twin cables are prohibited. Fillers must be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers must be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape must consist of a material that is compatible with the other components of the cable and must be lapped at least 10 percent of its width.

2.2.3 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables must not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit [cable manufacturing data](#). The following information must be provided by the cable manufacturer for each size, conductor quantity, and

type of cable furnished:

- a. Minimum bending radius, in inches - For multiple-conductor cables, this information must be provided for both the individual conductors and the multiple-conductor cable.
- b. Pulling tension and sidewall pressure limits, in pounds.
- c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.
- d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others must be stated. Also, if requested, recommendations must be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TEST REPORT(S), INSPECTION REPORT(S), AND VERIFICATION REPORT(S)

3.2.1 Cable Data

Do not begin any wire and cable fabrication until materials are submitted and approved by the Contracting Officer. Submit cable data for approval including, but not limited to, dimensioned sketches showing cable construction and sufficient additional data to show that wire and cable meet the requirements of this Section.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications must be made by and at the plant of the manufacturer, and the manufacturer must provide certification and certification reports of completed inspections and completed tests. The Government may require or perform further tests before or after installation. Testing in general must comply with NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Specific tests required for particular materials, components, and completed cables must be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests must also be performed in accordance with the additional requirements specified below. Submit certified copies of test reports.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits must be made with dc test voltages. Cables to be used exclusively on ac circuits must be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages must be used.

3.2.2.2 Flame Tests

All cable assemblies must pass either the vertical cable tray flame tests required by ICEA T-30-520 (stated in, but not required by NEMA WC 70), the vertical tray flame propagation test requirements of UL 1685 and IEEE 1202, the wire and cable burning characteristics test of the UL 2556 VW-1 Test, or (for control cables only) the flame test as required by NEMA WC 57. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests must be submitted. In this case the reports furnished

under paragraph "Reports," must include information, identify critical information, and verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.3 Independent Tests

The Government may make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.4 Reports

Furnish results of tests. No wire or cable must be shipped until authorized. Lot number and reel or coil number of wire and cable tested must be indicated on the test reports.

-- End of Section --

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SECTION 26 20 00

ELECTRICAL DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2016) Standard Specification for
Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE C2 (2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1 (2005) American National Standard for
Electrical Rigid Steel Conduit (ERSC)

NEMA 250 (2014) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA ICS 1 (2000; R 2015) Standard for Industrial
Control and Systems: General Requirements

NEMA ICS 2 (2000; R 2005; Errata 2008) Industrial
Control and Systems Controllers,
Contactors, and Overload Relays Rated 600 V

NEMA ICS 4 (2015) Application Guideline for Terminal
Blocks

NEMA ICS 6 (1993; R 2011) Industrial Control and
Systems: Enclosures

NEMA TC 2 (2013) Standard for Electrical Polyvinyl
Chloride (PVC) Conduit

NEMA TC 3 (2015) Standard for Polyvinyl Chloride
(PVC) Fittings for Use With Rigid PVC
Conduit and Tubing

NEMA Z535.4 (2011) American National Standard for
Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2017) National Electrical Code
- NFPA 70E (2015; ERTA 1 2015) Standard for Electrical Safety in the Workplace
- NFPA 780 (2017) Standard for the Installation of Lightning Protection Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

- 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

- UL 1063 (2006; Reprint Jul 2012) Machine-Tool Wires and Cables
- UL 1203 (2013; Reprint Apr 2015) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
- UL 44 (2014; Reprint Feb 2015) Thermoset-Insulated Wires and Cables
- UL 486A-486B (2013; Reprint Jan 2016) Wire Connectors
- UL 486C (2013; Reprint Jan 2016) Splicing Wire Connectors
- UL 489 (2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
- UL 50 (2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
- UL 508 (1999; Reprint Oct 2013) Industrial Control Equipment
- UL 510 (2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
- UL 514B (2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
- UL 6 (2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
- UL 651 (2011; Reprint Jun 2016) UL Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings
- UL 674 (2011; Reprint Jul 2013) Electric Motors

and Generators for Use in Division 1
Hazardous (Classified) Locations

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00.

SD-02 Shop Drawings

Marking strips drawings; G, DO

SD-03 Product Data

Combination motor controllers; G, DO

SD-06 Test Reports

600-volt wiring test

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G,

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, UL 651.

2.2.3 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.3.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.4 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.3.1 MOTOR CONTROL JUNCTION BOX

Provide a junction box rated NEMA 4X stainless steel with minimum dimensions (WxHxD) 6.5"x7.5"x3" to be used as a tap and distribution point to each of the three control cabinets.

2.3.2 HANDHOLE ENCLOSURE

Provide an open bottom handhole enclosure rated H20 for vehicular traffic with minimum dimensions (WxLxH) 8"x8"x9".

2.4 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.4.1 Handhole Splices

Splices performed within handholes must demonstrate methods of waterproofing.

2.5 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs): UL 508 and UL 489, and provided as shown. Provide MSCPs that consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. Rate MSCPs in accordance with the requirements of NFPA 70.

2.6 COMBINATION MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

- a. UL 508, NEMA ICS 1, and NEMA ICS 2.
- b. Provide liquid level sensors. Sensor must be submersible, capacitance type with 1A SPST relay output. Rated supply voltage must be compatible with 24VDC. Sensor must have an integrated cable of at least 10ft and have 3/4" mounting threads.
- c. Provide reduced voltage motor soft starters. Soft starter must utilize 3-phase 208VAC 60Hz, 24VDC for control power, and have a maximum current capacity of at least 37A. Phase loss detection, overload protection, and run bypass contactor must be integrated. Operating temperature must support, at a minimum, temperatures of -20 to 120 degrees Fahrenheit. Dimension must not exceed 6.5" in depth. Utilize Eaton S801+N37N3S or equivalent meeting salient characteristics.
- d. Provide a 24VDC power supply for the control circuitry. Power supply must support 3-phase 208VAC input and be rated 240W. Utilize Eaton PSG240E or equivalent meeting salient characteristics.
- e. Provide a circuit breaker for each pump enclosure. The circuit breaker must be 3 pole and rated for 208VAC and 80A. Dimensions must fit with the combination pump enclosure. Circuit breaker must interface with enclosure isolation switch.
- f. Provide a contactor for each pump enclosure. Contactor must be 3 pole, normally open with system voltage rated for 208VAC and operational current rated for 80A. Control circuit voltage must be rated 24VDC. One normally open auxiliary contact must be integrated into contactor.
- g. Provide a rotary isolator switch for the control circuitry. The switch must be 2 pole and rated at least 10A and at least 208VAC.
- h. Provide time-delay OFF relays for each pump enclosure. Must be rated for operating voltage of 24VDC. Contact rating must be at least 3A. Must support, at a minimum, a timer range of 1 second to 5 minutes.
- i. Provide time-delay ON relays for each pump enclosure. Must be rated for operating voltage of 24VDC. Contact rating must be at least 3A. Must support, at a minimum, a timer range of 1 second to 5 minutes.
- j. Provide a keyed switch for each pump enclosure. The switch must be rated 24VDC and be mounted such that it protrudes from a pre-scored punchout on the enclosure face and provides a watertight seal.
- k. Provide a run indicator light for each pump enclosure. The light must be LED and illuminate red via the lens cover. The light must be mounted such that it protrudes from a pre-scored punchout on the enclosure face and provides a watertight seal.
- l. Provide complete set of fuses for each motor starter. Fuses must be rated 10A, 250VAC/DC, 200kA RMS Sym., high speed, 14mm x 51mm, Bussmann Ferrule FWX or equivalent meeting stated salient characteristics.

2.6.1 Control Wiring

Provide control wiring in accordance with the following:

- a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting [UL 44](#), or Type MTW meeting [UL 1063](#), and passing the VW-1 flame tests included in those standards.
- b. Hinge wire: Class K stranding.
- c. Control wire minimum size: No. 14 AWG.
- d. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.
- e. Provide wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.6.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

- a. [NEMA ICS 4](#).
- b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.
- c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.
- d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.
- e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four (4) spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.
- f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.
- g. Submit data showing that any proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.6.2.1 Types of Terminal Blocks

- a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

2.6.3 Enclosures for Motor Controllers

[NEMA ICS 6](#).

- a. Provide combination pump enclosures that contain a lockable external isolation switch. The enclosure must be able to house the soft starter, circuit breaker, and contactor noted in this specification. The external switch is to be configured to actuate the circuit breaker within the enclosure. The enclosure must be rated NEMA 4X stainless steel. Utilize Eaton Box A1, Type 4X or equivalent meeting salient characteristics.
- b. Provide NEMA 4X stainless steel enclosure for control circuitry. Enclosure must have minimum dimensions of 12"x18"x5" (WxHxD).

2.7 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with [29 CFR 1910.147](#). Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.8 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by [NFPA 70](#): specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations: as indicated. Equipment in hazardous locations: comply with [UL 1203](#) for electrical equipment and industrial controls and [UL 674](#) for motors.

2.9 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.10 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

- a. [ASTM D709](#).
- b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
- c. Each nameplate inscription: identify the function and, when applicable, the position.
- d. Nameplates: melamine plastic, [0.125 inch](#) thick, white with black center core.
- e. Provide red laminated plastic label with white center core where indicated.
- f. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- g. Minimum size of nameplates: [one by 2.5 inches](#).

- h. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.11 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.12 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING .

2.13 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

- a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.
- b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.
- c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.
- d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.
- e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.
- f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Light Gray.
- g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit: continuous from

service entrance equipment to outdoor power system connection.

3.1.2 Hazardous Locations

Perform work in hazardous locations, as defined by NFPA 70, in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Provide conduit with tapered threads.

3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.1.4 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00, FIRESTOPPING.

3.1.4.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.5 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.5.1 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage,

including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

- (2) Do not use in hazardous (classified) areas.
- (3) Do not use in fire pump rooms.
- (4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.
- (5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.
- (6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.2 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.5.3 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.5.4 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for

digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.6 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations: sheet steel, except that nonmetallic boxes may be used with nonmetallic conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.6.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

3.1.6.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.7 Mounting Heights

Mount panelboards, circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor.

3.1.8 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.8.1 Marking Strips

Provide marking strips in accordance with the following:

- a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.
- b. Use permanent ink for the wire numbers
- c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.
- d. Size marking strips to accommodate the two sets of wire numbers.
- e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.
- f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.
- g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.9 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.11 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 25 ohms under dry conditions. Where resistance obtained exceeds 25 ohms, contact Contracting Officer for further instructions.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.4.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.4.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance: 250,000 ohms.

-- End of Section --

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DIVISION 31 - EARTHWORK

SECTION 31 00 00

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SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 11 (2005; R 2013) Standard Method of Test for Materials Finer Than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AASHTO T 96 (2015) Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM INTERNATIONAL (ASTM)

ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 (2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2167 (2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D422	(1963; R 2007) Standard Test Method for Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

State Specifications	(1988) Standard Specifications for Highways and Bridges; Supplemental Specifications Dated June 6, 2006; Standard Special Provisions Dated November 20, 2007
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, and SP-SC. Satisfactory materials for grading comprise stones less than four inches.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material.

1.2.2.1 Potentially Contaminated Materials

All materials in work areas are potentially contaminated above Commonwealth of Massachusetts DEP disposal criteria and may require special handling and disposal. A summary table of the contamination levels is provided in Section 00 32 00 GEOTECHNICAL DATA.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136,

ASTM D422, and ASTM D1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.5 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than three inches in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.6 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling that is performed merely to increase production.

1.2.7 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.8 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material is a uniformly graded washed sand with a maximum particle size of three inches and less than 5 percent passing the No. 200 size sieve, with not more than 3 percent by weight finer than 0.02 mm grain size.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G, DO

Excavation Work Plans; G, DO

Contracting Officer review will be completed within 42 calendar days after date of submission of these Plans.

SD-04 Samples

Gravel Borrow; G, RO

3/4-Inch Crushed Stone; G, RO

Stone Dust; G, RO

Dense-Graded Crushed Stone; G, RO

Sand; G, RO

Submit one sample for each material and for each source of material.

SD-06 Test Reports

Testing

Borrow Site Testing

Within 24 hours of conclusion of physical tests, six copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

1.4 SUBSURFACE DATA

Subsurface soil boring logs are discussed in Section 00 32 00 GEOTECHNICAL DATA. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.6 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work for any proposed dewatering.

1.7 EXCAVATION WORK PLANS

Submit work plans for each of the 12 work areas. Each plan shall include the following:

- a. A plan view showing access roads, fencing, storage areas, sheet piles and pump locations as required, laydown areas and any other pertinent information.
- b. A narrative describing procedures for mobilization and pre-excavation activities. (See also section 01 55 26 TRAFFIC REGULATION.)
- c. A narrative describing methods to access, remove, handle, and transport the sediment from the river bottom. Discuss methods to stabilize wet material, plans to handle and transport material, and the destination of material.
- d. Plans for dewatering work areas below the water table. Include plans for maintaining water quality including any required water testing. (See also section 02 40 00 CONTROL AND DIVERSION OF WATER.)
- e. A narrative of the landscaping effort including a discussion of the interim period, planting period, maintenance and establishment period.
- f. Final demobilization from each area.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE MATERIALS

Test all offsite materials brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until test results have been approved by the Contracting Officer.

2.2 GRAVEL BORROW

Select gravel borrow material for all backfill areas, except those constructed from crushed stone, stone dust, and dense-graded crushed stone shall consist of gravel material and shall conform to the requirements of Section M1.03.0, Type C "Gravel Borrow" of the State Specifications. Gravel bedding materials shall consist of sand, gravel or crushed stone composed of tough, durable particles and shall be reasonable free of thin, flat and elongated pieces. The materials shall contain no organic matter or soft friable particles in quantities considered objectionable by the Contracting Officer. The materials shall be well graded within the limits specified below:

Sieve Size (U.S. Standard)	Percent Passing by Dry Weight
2-inch	100
0.5-inch	50-85

Sieve Size (U.S. Standard)	Percent Passing by Dry Weight
No. 4	40-75
No. 50	8-28
No. 200	0-10

2.3 3/4-INCH CRUSHED STONE

3/4-inch Crushed Stone Bedding shall conform to Section M.2.01.4 of the [State Specifications](#) and shall also consist of crushed stone of one or the other of the following material:

1. Durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, and free from a detrimental quantity of thin, flat, elongated* or other objectionable pieces. A detrimental quantity will be considered as any amount in excess of 15% of the total weight.
2. Durable gravel bedding obtained by artificial crushing of gravel boulders or fieldstone with a minimum diameter before crushing of 8 in.

*Thin or elongated pieces are defined as follows: Thin stones shall be considered to be such stones whose average width exceeds four (4) times their average thickness. Elongated stones shall be considered to be such stones whose average length exceeds four (4) times their average width.

The crushed stone shall be reasonably free from clay, loam or deleterious material and not more than 1.0% of the satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone. Where crushed stone is to be used for surfacing, this requirement shall be not more than 0.5% of satisfactory material passing a No. 200 sieve.

The crushed stone shall have a maximum percentage of wear as determined by the Los Angeles Abrasion Test ([AASHTO T 96](#)) as follows:

- a. For Class I Bit. Conc.: 30%**
- b. For Cement Concrete Aggregate: 45%***
- c. Crushed Stone for Subbase: 45%
- d. Special Borrow Ledge: 45%

**Crushed stone for this use shall consist of crushed or shattered natural rock only. Gravel bedding will not be permitted.

***Except for 5000 psi or greater cement concrete and prestressed concrete which shall be 30%

The crushed stone shall be uniformly blended according to the grading requirements for the respective stone sizes shown in the following Table from the [State Specifications](#).

Tabulation of Stone Sizes
Percent by Weight Passing Through

Square Opening M2.01.4
Sieve

Tabulation of Stone Sizes
Percent by Weight Passing Through
¾ in.

2 ½ in.	
2 in.	
1 ½ in.	
1 ¼ in.	
1 in.	100
¾ in.	90-100
5/8 in.	
½ in.	10-50
3/8 in.	0-20
No. 4	0-5
No. 8	
No. 16	

2.4 STONE DUST

Stone dust for pathway repair and construction shall be clean, hard, fine crushed stone aggregate graded within the following limits:

Sieve Size (U.S. Standard)	Maximum Percent Passing by Weight
3/8-inch	100
No. 4	90-100
No. 8	75-80
No. 16	55-65
No. 30	40-50
No. 50	25-35
No. 100	15-20
No. 200	10-15

2.5 DENSE-GRADED CRUSHED STONE

Dense-Graded Crushed Stone shall conform to the requirements of Section M2.01.7, "Dense-Graded Crushed Stone for Sub-base" of the [State Specifications](#). Dense-Graded Crushed Stone shall be a material combining crusher-run coarse aggregates of crushed stone and fine aggregates of natural sand or stone screenings, uniformly premixed with a predetermined quantity of water. Coarse aggregate shall consist of hard, durable particles of fragments of stone. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used. Coarse aggregate shall have a percentage of wear, by the Los Angeles Test, or not more than 45. Fine aggregate shall consist of natural or crushed sand. The composite material shall be free from clay, loam, or other plastic material, and shall conform to the following gradation requirements:

Sieve Size (U.S. Standard)	Maximum Percent Passing by Weight
2 inch	100
1-1/2 inch	70-100
3/4 inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

2.6 SAND

Sand shall conform to Section M.1.04.0 of the [State Specifications](#) for "Sand Borrow", Type a. Sand shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coatings and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by [AASHTO T 11](#) shall not exceed 10% by weight. The maximum particle size for sand shall be 1/4-inch.

2.7 INITIAL APPROVAL

At least 30 days prior to the initial placement of any [Gravel Borrow](#), [3/4-Inch Crushed Stone](#), [Stone Dust](#), [Dense-Graded Crushed Stone](#), and [Sand](#) the Contractor shall submit the locations of the proposed sources and the names of the processing firms. A 50 pound bulk sample of representative fill materials shall be submitted for approval of gradation and for the soundness and durability of the gravel, sand and stone particles, for each material and for each source of material.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where topsoil exists in work areas and requires removal, strip to a maximum depth of six inches. Spread topsoil on areas already graded and prepared for topsoil, or transport and deposit in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated, specified or approved by the Contracting Officer. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than two inches in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile surplus topsoil from excavations and gradings.

3.2 RIVER SEDIMENT EXCAVATION

3.2.1 General

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. After excavation of river sediments, testing and disposal shall be in accordance with "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills", as issued by the Massachusetts Department of Environmental Protection (Policy #Comm-97-001). Excavations may be performed mechanically in wet conditions or by the establishment of water diversion structures with excavation performed in dry conditions (see Section [02 40 00](#) CONTROL AND DIVERSION OF WATER for additional information concerning water diversion structures). Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage. Dispose unsatisfactory excavated material offsite, as stated above. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits or from other approved areas selected by the Contractor as specified.

3.2.1.1 Debris in Excavated River Sediments

The Contractor may encounter natural and man-made debris while performing river sediment excavation. The natural debris may include downed trees and limbs, stones, and layers of leaf litter mixed with brush including Phragmites shoots, roots, and rhizomes. Man-made debris may include construction debris, shopping carts, tires, metal machine parts and other scrap metal, safe doors, automobile parts, bottles and cans, general household debris, discarded hypodermic needles and syringes, plastic items of all kinds, and general trash. The Government has no knowledge of artificial obstructions of such size or character as to require the use of special or additional excavation equipment, beyond that used for the excavation of the river sediment.

During excavation operations, the Contractor shall remove all debris possible. Debris removed from the excavation area shall be separated and stockpiled for disposal separate from the disposal of river sediment. Disposal of this debris shall be in accordance with local, Federal, and State laws and regulations shall be the responsibility of the Contractor. In case the actual conditions differ from those stated above, an adjustment in contract price or time of completion, or both, will be considered in accordance with "FAR 52.236-2, Differing Site Conditions."

3.2.1.2 Drainage When Excavation is in the Dry

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage control measures at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.2 Excavation for Side Slopes

Excavation on side slopes shall follow, as closely as practicable, the lines indicated on the contract drawings. The amount of material excavated from side slopes will be determined by either cross-sections or computer, or both.

3.3 ALL OTHER EXCAVATION

3.3.1 Excavation for Appurtenances

Provide excavation for the pump station, manholes, catch-basins, inlets, or similar structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special

care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.3.2 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than four feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than or equal to 24 inch inside diameter, and do not exceed 36 inch plus pipe outside diameter for sizes larger than 24 inch inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.3.3 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of three inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.3.4 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material 12 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.3.5 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with gravel borrow. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.4 DEWATERING

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within three feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least two feet below the working level. Operate

dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift and piping. Also, see Section 31 01 00 TEMPORARY EXCAVATION SUPPORT SYSTEMS, Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING, and Section 01 57 20 ENVIRONMENTAL PROTECTION for additional requirements. The Contractor shall note the requirement for Remediation GP, Dewatering, and TRAC Permits.

3.5 UNDERGROUND UTILITIES

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer. Protective measures shall include steel plates or temporary fill.

3.6 STRUCTURAL EXCAVATION

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

3.7 SHORING

See Section 31 01 00 TEMPORARY EXCAVATION SUPPORT SYSTEMS.

3.8 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

If using cast-in-place concrete, do not excavate to final grade until just before concrete is to be placed. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond.

3.9 GROUND SURFACE PREPARATION

3.9.1 General Requirements

Remove and replace unsatisfactory material with gravel borrow, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of six inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of six inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.9.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.9.3 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of six inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. Do not vary the elevation of the finish subgrade more than 0.1 foot from the established grade and cross section.

3.9.4 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact to at least 92 percent of laboratory maximum density as determined by [ASTM D1557](#).

3.10 BACKFILLING AND COMPACTION

3.10.1 Backfill and Compaction for Structures, Roads, and Pathways

After the manhole, catchbasin, inlet, pump station or similar structure has been constructed and the concrete has been allowed to cure for five days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth.

Prepare ground surface on which backfill is to be placed as specified in paragraph GROUND SURFACE PREPARATION. Finish compaction by pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Place gravel borrow material on the prepared subgrade and compact to at least 95 percent laboratory maximum density as determined by [ASTM D1557](#).

3.10.2 Backfill and Compaction for Gravel Bedding for Riprap Placement

Prepare ground surface on which backfill is to be placed as specified in paragraph GROUND SURFACE PREPARATION. Deposit backfill in layers of a maximum of 6 inches loose thickness. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Place gravel borrow material on the prepared subgrade and compact to at least 90 percent laboratory maximum density as determined by [ASTM D1557](#). Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.10.3 Bedding and Initial Backfill

Provide sand for pipe and conduit bedding of the thickness shown on the contract drawings. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Compact backfill to top of pipe to 90 percent of [ASTM D1557](#) laboratory maximum density.

3.11 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated. Finish in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turving materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.11.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. The Contractor is responsible for protecting and maintaining the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade.

3.12 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with [ASTM D1556](#), [ASTM D2167](#), or [ASTM D6938](#). When [ASTM D6938](#) is used, check the calibration curves and adjust using only the sand cone method as described in [ASTM D1556](#). [ASTM D6938](#) uses a wet unit weight of soil in determining the moisture content of the soil. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in [ASTM D6938](#); check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.12.1 Backfill Materials Gradation

One test per 500 cubic yards, or fraction thereof, for each backfill material, stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with [ASTM D2487](#) and [ASTM D422](#) as required.

3.12.2 In-Place Densities

One test per 400 square feet, or fraction thereof, of each lift of backfill for utility trenches, under pavements, and under stone dust paths.

3.12.3 Moisture Contents

For stockpiled materials, perform a minimum of two moisture tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.12.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density ([ASTM D1557](#)).

3.13 DISPOSITION OF SURPLUS MATERIAL

Dispose surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber off the project site.

3.13.1 Sampling and Testing of Excavated Materials

For bidding purposes, the Offerors shall assume that excavated wetland soil and sediment removed from all areas must be disposed of at in-state or out-of-state lined landfills. A compilation of wetland soil and sediment test results from the project area is provided with these Specifications as an appendix. The most recent testing was conducted by AECOM (Battelle) in 2014. This information was sufficient to obtain Water Quality Certification from the Massachusetts Department of Environmental Protection (MA DEP) and Orders of Conditions from Boston and Brookline. For disposal purposes the landfill Operators may require the Contractor to conduct additional sampling and testing as described in "Reuse and Disposal of Contaminated Soil at Massachusetts Landfills. Department of Environmental Protection Policy # COMM-97-001" and/or pursuant to facility-specific requirements.

The results of any additional testing shall be submitted to the Government. A summary table of chemical test data for soils and subsoils and the Geotechnical Engineering Report containing the chemical laboratory Analytical data are provided in the Appendix to the specifications. Test results generally meet MA RCS-1 standards for reuse. The Contractor shall conduct any additional testing required by the landfill or other receiving party prior to disposal or reuse, and shall submit all test results to the Government. The Contractor is also required to conduct additional sampling and testing of all topsoil reused on site according to Section [32 93 00](#) EXTERIOR PLANTING AND HABITAT RESTORATION. The Contractor

shall notify the Contracting Officer when encountering any unanticipated potentially contaminated materials, and the Contractor shall test, transport and dispose of such material pursuant to applicable Federal, State, and local laws and regulations.

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SECTION 31 01 00

TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

The work of this section includes the following:

1. Design, furnish and install temporary excavation support systems as required to maintain lateral support, prevent loss of ground, protect trees and roots to remain, limit soil movements to the allowable limits indicated, and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, and other facilities. The location, configuration, design, construction and maintenance of the excavation support walls and internal bracing shall be the sole responsibility of the Contractor.
2. The temporary excavation support system to be used on this project includes singular or multiple stages comprised of internally braced interlocking steel sheeting, soldier piles and timber lagging or trench box.
3. Wherever the word "sheeting" is used in this section or on the contract drawings, it shall be in reference to interlocking steel sheeting or steel soldier piles and timber lagging support systems.
4. Construction of the temporary excavation support system shall not disturb existing structures, completed structures, or trees to remain.
5. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval, or cave-ins as a result of improper installation, maintenance, or design of the temporary excavation support systems. The Contractor shall pay for all claims, costs, and damages that arise as a result of the work performed at no additional cost to the Government.
6. Monitoring movement of the lateral support systems by optical survey techniques and of groundwater via observation wells is required, as detailed in Section 33 01 00 GEOTECHNICAL INSTRUMENTATION.
7. If, in the Contracting Officer's judgment, the performance of the excavation support system is deemed unacceptable, the Government may instruct the Contractor to stop work and implement its approved remedial action plan to arrest further movements or restore groundwater levels to pre-construction levels. The Contractor shall take immediate steps to implement the plan of action. The costs for implementing plans of action shall be borne by the Contractor.
8. Temporary excavation support systems shall be designed and installed in accordance with the EM 385-1-1.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A328/A328M (2007) Standard Specification for Steel
Sheet Piling

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

State Specifications (1988) Standard Specifications for
Highways and Bridges; Supplemental
Specifications Dated June 6, 2006;
Standard Special Provisions Dated November
20, 2007

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements
Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926 Safety and Health Regulations for
Construction

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications; G, RO

Submit the following qualifications at least four weeks prior to the start of installation of the excavation support systems:

a. Qualifications of Contractor's temporary excavation support system designer.

b. Qualifications of Contractor's temporary excavation support system installer.

c. Qualifications of construction superintendent for temporary earth support system installation.

Temporary Excavation Support Plan; G, DO

Submit a temporary excavation support plan stamped and signed by a Professional Civil Engineer registered in the Commonwealth of Massachusetts at least three weeks prior to the start of installation of the excavation support system, together with design calculations for review. The Contractor shall remain responsible for the adequacy and safety of the means, methods, and sequencing of construction. The plan shall include the following items as a minimum:

a. Excavation support system, details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

b. Requirements of dewatering during the construction.

c. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

d. List of equipment used for installing the excavation support systems.

Construction Action Plan; G, RO

Submit a Construction Action Plan specifying the methods and procedures to maintain excavation support system stability and maintain groundwater levels outside the excavation, if the allowable movement of the adjacent ground and adjacent structures is reached or a drawdown in groundwater levels beyond the allowable values is experienced.

SD-02 Shop Drawings

Estimates of the Lateral and Vertical Displacements; G, RO

The Contractor shall submit estimates of the lateral and vertical displacements of the excavation lateral support systems under applied loads at critical stages.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01 45 00 QUALITY CONTROL and as specified.

B. Conform to the requirements of 29 CFR 1926, Subpart P, "Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

C. All welding shall be performed in accordance with AWS D1.1/D1.1M.

D. Prepare design, including calculations and drawings, under the direction of a Professional Civil Engineer registered in the Commonwealth of Massachusetts and having the following qualifications:

1. Not less than five years experience in the design of soldier pile and lagging and steel sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and

complexity as this project.

2. Completed not less than five successful soldier pile and lagging and steel sheeting temporary excavation support system projects of comparable type, size, and complexity as this project.

E. Temporary Excavation Support System Installer's Qualifications:

1. Not less than five years experience in the installation of soldier pile and lagging and steel sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed not less than five successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project.

F. Install all temporary excavation support systems under the supervision of a superintendent having the following qualifications:

1. Not less than five years experience in installation of soldier pile and lagging and steel sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed at least five successful soldier pile and lagging and steel sheeting temporary excavation support system projects of comparable type, size, and complexity as this project.

G. Provide instrumentation monitoring during construction in accordance with Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING.

1.5 DESIGN CRITERIA

Design of temporary excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, traffic, temporary stockpiles, construction loads, and other surcharge loads.

2. Design internal bracing or external tiebacks to provide sufficient reaction to maintain stability.

3. Limit movement of ground adjacent to the excavation support system.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall be more than 10 feet below the bottom of the excavation, or 5 feet into the marine clays, whichever is deeper.

5. Design temporary excavation support system to withstand an additional 3 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

1.6 DELIVERY, STORAGE AND HANDLING

Store sheeting and bracing materials to prevent sagging, which would

produce permanent deformation. Keep concentrated loads, which occur, during stacking or lifting below the level which would produce permanent deformation of the material.

1.7 PROJECT/SITE CONDITIONS

A. Subsurface investigation data are available as referenced in Section 00 32 00 GEOTECHNICAL DATA, Appendix A. The geotechnical data is made available to the Contractor for informational purposes only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, or other data.

B. Prior to submitting a bid, the Contractor shall review and understand the information contained in the geotechnical data and all Contract Documents.

C. The Contractor shall draw his own conclusions regarding site conditions based upon site visit(s) and from available sources, for which the Government and its Consultants assume no responsibility. The Contractor shall assume that subsurface conditions between subsurface explorations could differ from conditions shown in the records of the explorations.

D. The Contractor shall notify the Government immediately if obstructions are determined to conflict with the location of the excavation support system. Cobbles and boulders within fills and all other competent naturally deposited soils will not be considered obstructions.

E. The Contractor shall protect adjacent structures above ground and buried from damage associated with lateral support of excavation operations and other operations. Damage due to lateral excavation support operations, dewatering, or other Contractor activities shall be repaired immediately by the Contractor at his own expense.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Steel

All soldier piles, wales, rakers, struts, wedges, plates, waterstop, tiebacks, and accessory steel shapes shall conform to current ASTM Standards. Sheet piling shall conform to ASTM A328/A328M.

2.1.2 Timber Lagging Left-in-Place

Structural grade having a nominal thickness of 3 inches and a minimum allowable working stress of 1100 psi.

2.1.3 Other Materials

Tamping tools adapted for backfilling voids after removal of the excavation support system.

Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in 29 CFR 1926, Subpart P.

PART 3 EXECUTION

3.1 GENERAL

A. Installation of the temporary excavation support system shall not commence until the Government has reviewed the related earth excavation and dewatering submittals with all Government comments satisfactorily addressed.

B. Install excavation support system in accordance with the Contractor's temporary excavation support plan.

C. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of abutting buildings and structures.

D. Perform preparatory work to discover, protect, maintain and restore, or remove utilities, foundations or other facilities located in close proximity of the proposed excavation lateral support system.

E. Conduct pre-excavation as necessary to remove obstructions and identify existing utilities along the alignment of the excavation lateral support system which will interfere with installation in accordance with Section 31 00 00 EARTHWORK.

F. The Contractor shall provide fully equipped rig(s) and appropriate tools in full-time operation at the site during the work, and shall mobilize additional equipment, if necessary, to complete the work on schedule.

G. Excavation shall not proceed more than 2 ft below the bracing level, anywhere within the excavation support limits, until the entire level of bracing is completely installed, including prestressing.

H. Install settlement and lateral deformation monitoring points on the temporary support of excavation system and observation wells as shown and as specified in Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING. Notify the Government immediately if any monitoring points or observation wells are damaged. Repair or replace damaged instruments and re-establish new baseline for damaged instruments at no additional cost to the Government prior to proceeding with the construction of excavation and support of excavation work. The Contractor shall allow the Government safe access to monitor the points along the support system at no additional cost.

I. The Contractor shall continuously monitor movements of the excavation support system. In the event of the measured movements approaching or exceeding the allowable movements indicated in Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Action Plan) as required.

J. The Contractor shall continuously monitor groundwater levels outside the excavation at the locations shown on the contract drawings. In the event of the measured water levels approaching or exceeding the allowable levels indicated in Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING, take immediate steps to prevent further reduction by revising procedures such as providing a groundwater recharge systems (Construction Action Plan).

3.2 INSTALLATION - INTERLOCKING STEEL SHEETING

A. Length Markings: Before installation is started, each steel section shall be marked so that the depth of the tip can be readily determined. This shall be accomplished by a method that is approved by the Government.

B. The Contractor shall take all precautions against excessive vibrations in all areas. The Contractor shall be solely responsible for any damages caused directly or indirectly to structures, sewer and other utilities, and shall repair any such damage occurring due to his operations to the satisfaction of the Government.

C. Sheeting shall be protected from damage during installation.

D. All sheeting shall be pushed to its full depth ahead of the excavation so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with structural fill and thoroughly compacted.

E. Requirements for the sheeting include the following:

1. Install sheeting in the plumb position.
2. Install sheeting such that the piling is in direct contact with the material to be retained.
3. Install sheeting to the depths indicated on approved Shop Drawings.
4. Methods and equipment used in pushing, setting, cutting and splicing shall conform to submitted Shop Drawings.
5. Use templates or other temporary alignment facilities to maintain piles plumb and on line.
6. Control vibrations and noise associated with installation.
7. Pre-excavate as necessary to remove existing structures along alignment of the sheeting.
8. Sheeting shall be positioned to the design plan location along its length from top to bottom of excavation grade. Design plan locations are to be established by the Contractor's Professional Engineer and submitted to the Government for review.

F. The Contractor shall provide all inspection equipment to determine whether the sheeting has been started in their planned location, are vertical, and are within the allowable tolerance for position after installation.

3.3 SOLDIER PILES AND TIMBER LAGGING

A. Install steel soldier piles before starting excavation. Install soldier piles by drilling or driving to the design tip elevation. Drilled methods shall prevent loss of ground around the hole. Each soldier pile shall be installed in its drilled hole within 2 hours after drilling is completed to the required depth.

B. The Contractor shall have equipment on-site able to advance the drilled hole, for installation of the soldier piles, through sand below the water

table, through concrete, and through large boulders and other obstructions which may be encountered.

C. Space soldier piles at intervals indicated on the Shop Drawings. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

D. Within the same day of seating the soldier piles in the drilled holes, encase the piles with "Controlled Density Fill, Type 1E", as specified in Section M4.08.0 of the [State Specifications](#), from the tip elevations to the currently existing ground surface. Crushed stone or other granular materials are not acceptable.

E. Prior to completion of the final backfilling operations, soldier piles shall be cut off five feet below the final ground surface.

F. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. As installation progresses, backpack the voids between the excavation face with sand and on-site soils to establish a tight contact. Pack louver openings between lagging with hay or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking. In no case shall the louvered openings be allowed to exceed 1-inch.

G. Beginning at the top of the soldier piles, the maximum permissible height of unlagged face of excavation shall not exceed 2-feet in all soil types encountered at the site. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed 8-inches.

H. If unstable ground is encountered, take suitable measures (grouting behind the lagging or other approved method) to retain the material in place and prevent loss of ground or movements.

3.4 VIBRATION MONITORING

Requirements for vibration monitoring during sheet or soldier pile driving operations are contained in Section 33 01 00 GEOTECHNICAL INSTRUMENTATION AND MONITORING. Vibration monitoring shall be performed preconstruction, to establish baselines, during construction, and in response to abutter complaints, as directed by the Contracting Officer.

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GEOTEXTILE

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SECTION 31 05 19

GEOTEXTILE

PART 1 GENERAL

1.1 Summary

This section covers the requirements for geotextile used on this project.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4354	(1999; R 2009) Sampling of Geosynthetics for Testing
ASTM D4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011) Determining the Specification Conformance of Geosynthetics
ASTM D4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D6241	(2014) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread; G, DO

A minimum of 30 days prior to scheduled use, proposed thread type for sewn seams along with data sheets showing the physical properties of the thread.

Manufacturing Quality Control Sampling and Testing; G, DO

A minimum of 30 days prior to scheduled use, manufacturer's quality control manual.

SD-04 Samples

Quality Assurance Samples and Tests; G, DO

Samples for quality assurance testing; 30 days shall be allotted in the schedule to allow for testing.

SD-07 Certificates

Geotextile; G, DO

A minimum of 30 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D4873.

1.4.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.4.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.4.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile for Riprap and Paths

Geotextiles shall be a nonwoven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextiles shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Tables 1 and 2 below. Where applicable, Tables 1 and 2 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1 - GEOTEXTILE FOR RIPRAP
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	180	ASTM D4632
CBR PUNCTURE	LBS	450	ASTM D4833
TRAPEZOID TEAR	LBS	75	ASTM D4533
APPARENT OPENING SIZE	U.S. SIEVE	70	ASTM D4751
PERMITTIVITY	SEC -1	1.4	ASTM D4491
ULTRAVIOLET DEGRADATION	PERCENT	70 AT 500 HRS	ASTM D4355

An acceptable geotextile product for riprap is "Mirafi 170N" as

manufactured by Nicolon Corporation, or approved equal.

TABLE 1 - GEOTEXTILE FOR PATHS
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	250	ASTM D4632
CBR PUNCTURE	LBS	700	ASTM D6241
TRAPEZOID TEAR	LBS	100	ASTM D4533
APPARENT OPENING SIZE	U.S. SIEVE	100	ASTM D4751
PERMITTIVITY	SEC -1	0.8	ASTM D4491
ULTRAVIOLET DEGRADATION	PERCENT	70 AT 500 HRS	ASTM D4355

An acceptable geotextile product for paths is "Mirafi 1100N" as manufactured by Nicolon Corporation, or approved equal.

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.1.3 Geogrid

Geogrid shall be composed of high molecular weight, high tenacity polyester multifilament yarns which are woven in tension and finished with a PVC coating. Geogrid shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids. Geogrid shall meet the requirements specified in Tables 3 below. Where applicable, Table 3 property values represent minimum average roll values (MARV) in the weakest principal direction.

TABLE 3 - GEOGRID
MINIMUM PHYSICAL REQUIREMENTS FOR GEOGRID

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
TENSILE STRENGTH AT ULTIMATE	LBS/FT	4,700	ASTM D4632
CREEP RUPTURE STRENGTH	LBS/FT	3,241	ASTM D4632
LONG TERM DESIGN STRENGTH	LBS/FT	2,684	ASTM D6241

An acceptable geogrid product is "Miragrid 5XT" as manufactured by Nicolon Corporation, or approved equal.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the Contracting Officer. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The Contractor shall provide quality assurance samples to a USACE approved laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 31 00 00 EARTHWORK and Section 35 31 19 STONE PROTECTION AND GRAVEL BEDDING.

3.2.2 Placement

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 12 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn. The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. For field and factory seams which are sewn, the Contractor shall provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided. Quality Assurance seam samples shall be provided to the Government at the request of the Contracting Officer. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of overlap.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the

geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 7 psi shall be used to place the first lift over the geotextile. A minimum of 12 inches of soil or gravel bedding shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 00 00 EARTHWORK. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 2 mph.

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SECTION 31 11 00

TREE REMOVAL

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Tree Removal and Grubbing Plan; G, DO

The Contractor shall submit a Tree Removal and Grubbing Plan. The Plan shall show all areas where tree removal is required, areas where grubbing shall be performed, and disposal plans for resulting debris. The Plan shall also include procedures for the inspection of susceptible tree species for the presence of the Asian Long Horned Beetle, and Emerald Ash Borer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Heritage Trees

The Contractor shall avoid all damage to Heritage Trees located both within and outside the limits of work. Heritage trees are identified on the internet at the following location:

<https://kzla.maps.arcgis.com/apps/Shortlist/index.html?appid=0071cf3a1d0147c2b815563a1bb>

3.1.2 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.3 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require. See Section 01 57 20 ENVIRONMENTAL PROTECTION, Subpart "Protection of Existing Vegetation".

3.1.4 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter

with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service.

3.2 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

The Contractor shall note that in certain areas, tree removal is required but grubbing shall not be performed, or need not be performed as a separate activity. These areas include:

1. Areas which are to be excavated following tree removal. In these areas, grubbing can be performed as part of the general excavation, e.g., certain areas along the Riverway and the Back Bay Fens.
2. Trees to be removed located within 12 feet of paths. Grinding stumps below ground level and covering with topsoil and seed is required in these areas to avoid damage to the paths. Grinding of stumps shall be performed to 16 inches below the ground surface. The areas shall then be covered in four inches, minimum, of topsoil and seeded with Sun and Shade Mix, or temporary seed mix, as specified in Section 32 92 19 SEEDING, Subpart "Seed Mixtures".
3. Trees greater than 3 inches in diameter shall be marked prior to removal. The Contracting Officer shall inspect marked trees with the Contractor and confirm need to remove prior to removal. The Contractor is encouraged to clear as few trees as possible and some trees marked for removal on project plans may be spared, as approved by the Contracting Officer.
4. The Contractor is also responsible for removal of hazard trees and hazardous branches in the work area as identified by the Contracting Officer. Tree and branch hazards shall be identified by the Contracting Officer, upon consultation with the Arborist and Project Sponsors. Tree removal, tree and pruning shall be supervised by a Massachusetts Certified Arborist, who is present on the project site while work is being performed.

3.3 ASIAN LONG HORNED BEETLE AND EMERALD ASH BORER

The work area for this project is within a formerly designated Asian long horned beetle (ALB) regulated area (see <http://www.cityofboston.gov/eeos/ALB.asp>). The Contractor shall inspect downed tree species for the presence of ALB before they are removed from the site. Susceptible species include Acer (maple), Aesculus (horsechestnut), Albizia (mimosa), Betula (birch); Celtus (hackberry), Fraxinus (ash); Plantanus (sycamore), Populus (poplar), Salix (willow), Sorbus (mountain ash), Ulmus (elm), and Cercidiphyllum japonicum (Katsura). If any suspected ALB damage or ALB is observed, notify the Contracting Officer immediately. No plant material with suspected ALB damage or ALB shall be removed from site until permission is granted by the Contracting Officer and regulatory authorities.

The entire state of Massachusetts is an Emerald Ash Borer quarantine area. The Contract shall comply with all Federal and State regulations involving transport of any ash wood from the project area.

3.4 GRUBBING

Grubbing, where required, shall consist of the removal and disposal of stumps, roots larger than three inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.5 DISPOSAL OF MATERIALS

All timber on the project site noted for removal shall become the property of the Contractor and shall be removed from the project site and disposed of off site.

The Contractor shall note that some logs shall be saved for restoration purposes as described in Section 32 93 00 EXTERIOR PLANTING AND HABITAT RESTORATION, Subpart HABITAT LOG.

Written permission to dispose of such products on private property shall be filed with the Contracting Officer. Logs, stumps, roots, brush, rotten wood, and other refuse shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

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SECTION 31 41 16

METAL SHEET PILING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for metal sheet piling for temporary diversion structures should the Contractor choose to use sheet piling in the construction of temporary diversion structures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A328/A328M (2007) Standard Specification for Steel
Sheet Piling

ASTM A6/A6M (2011) Standard Specification for General
Requirements for Rolled Structural Steel
Bars, Plates, Shapes, and Sheet Piling

1.3 SYSTEM DESCRIPTION

Submit to the Contracting Officer for approval descriptions of pile driving equipment to be employed in the work. Descriptive information includes manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, and templates.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Sheet Piling; G, RO

Detail drawings for sheet piling, including fabricated sections, showing complete piling dimensions and details, driving sequence and location of installed piling. Include in the drawings details of top protection, special reinforcing tips, tip protection,

lagging, splices, fabricated additions to plain piles, cut-off method, corrosion protection, and dimensions of templates and other temporary guide structures for installing piling. Provide details of the method for handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

SD-03 Product Data

Driving

Records of the completed sheet piling driving operations, including a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

File Driving Equipment; G, RO

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances, prior to commencement of work.

Pulling and Redriving; G, RO

The proposed method of pulling sheet piling, prior to pulling any piling.

SD-06 Test Reports

Materials Tests

Certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots prior to installing materials. Material test reports shall meet the requirements of ASTM A6/A6M.

SD-07 Certificates

Material Certificates; G, RO

SD-11 Closeout Submittals

File Driving Record

Record for each sheet pile driven, as specified.

1.5 QUALITY ASSURANCE

1.5.1 Material Certificates

For each shipment, submit certificates identified with specific lots prior to installing piling. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be

accompanied by certified test reports. Provide the manufacturer's logo and mill identification mark on the sheet piling as required by the referenced specifications. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks; as a minimum, support on level blocks or racks spaced not more than 10 feet apart and not more than 2 feet from the ends. Storage of sheet piling should also facilitate required inspection activities and prevent damage to coatings and corrosion prior to installation.

PART 2 PRODUCTS

2.1 METAL SHEET PILING

Metal sheet piling shall be hot-rolled steel sections conforming to ASTM A328/A328M.

2.1.1 Interlocks

The interlocks of sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed.

2.1.2 General Requirements

Sheet piling, including special fabricated sections, shall be full-length sections of the dimensions shown. Provide fabricated sections conforming to the requirement and the piling manufacturer's recommendations for fabricated sections. Provide sheet piling with standard pulling holes.

2.2 APPURTENANT METAL MATERIALS

Provide metal plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials conforming to manufacturer's standards and to the requirements specified in the respective sheet piling standards.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified.

2.3.1 Materials Tests

Perform materials tests conforming to the following requirements. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations. Testing of sheet piling shall meet the requirements of ASTM A6/A6M.

PART 3 EXECUTION

3.1 EARTHWORK

Perform in accordance with Section 31 00 00 EARTHWORK. Pre-excavation will not be permitted. Backfill as indicated.

3.2 INSTALLATION

3.2.1 [Pile Driving Equipment](#)

Provide pile driving equipment conforming to the following requirements.

3.2.1.1 Driving Hammers

Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The driving energy of the hammers shall be between 8,750 and 16,000 foot-pounds as recommended by the manufacturer for the piling weights and subsurface materials to be encountered. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

3.2.1.2 Jetting Equipment

Jetting will not be permitted.

3.2.2 Placing and Driving

3.2.2.1 Placing

Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings. Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall. The Contractor shall take care to avoid damage to trees during piling installation.

a. Pilings shall be carefully located as shown or directed. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/4 inch per foot of length and true to line. Place the pile so the face will not be more than 6 inches from vertical alignment at any point. Top of pile at elevation of cut-off shall be within 1/2 inch horizontally and 2 inches vertically of the location indicated. Manipulation of piles to force them into position will not be permitted. Check all piles for heave. Redrive all heaved piles to the required tip elevation.

b. Provide temporary wales, templates, or guide structures to ensure that the pilings are placed and driven to the correct alignment. Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the sheet piling until design tip elevation is achieved. Templates shall not move when supporting sheet piling. Fit templates with wood blocking to bear against the web of each alternate sheet pile and hold the sheet pile at the design location alignment. Provide outer template straps or other restraints as necessary to prevent the sheets from warping or wandering from the alignment. Mark template for the location of the leading edge of each alternate sheet pile. If in view, also mark the second level to assure that the piles are vertical and in position. If two guide marks cannot be seen, other means shall be used to keep the sheet pile vertical along its leading edge.

3.2.2.2 [Driving](#)

Drive pilings with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

- a. Maintain driving hammers in proper alignment during driving operations by use of leads or guides attached to the hammer.
- b. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Remove and replace pilings damaged during driving or driven out of interlock at the Contractor's expense.
- c. Drive pilings without the aid of a water jet.
- d. Take adequate precautions to ensure that pilings are driven plumb. Where possible, drive Z-pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings.
- e. Pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. Incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile shall not be more than 2 feet below any adjacent sheet pile. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling.
- f. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed to ensure the adequacy and stability of the structure. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings. A tolerance of 2 inches above the indicated top elevation will be permitted. Pilings shall not be driven within 100 feet of concrete less than 7 days old.
- g. Pre-augering or spudding of piles will not be permitted.

3.2.3 Cutting-Off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed at no additional cost to the Government.

- a. Pilings adjoining spliced pilings shall be full length unless otherwise approved. Splicing of pilings shall be as indicated. Ends

of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. Shop and field welding, qualification of welding procedures, welders, and welding operators shall be in accordance with [AWS D1.1/D1.1M](#).

b. The tops of pilings excessively battered during driving shall be trimmed when directed, at no cost to the Government. Piling cut-offs shall become the property of the Contractor and shall be removed from the site.

c. Cut holes in pilings for bolts, rods, drains or utilities in a neat and workmanlike manner, as shown or as directed. Use a straight edge in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods and other items to be inserted. Do not use explosives for cutting.

3.2.4 Inspection of Driven Piling

Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of the Contracting Officer. Inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.3 REMOVAL

The removal of sheet pilings shall consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as directed.

3.3.1 Pulling

The method of pulling piling shall be approved. Provide pulling holes in pilings, as required. Extractors shall be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during pulling, the Contractor will be required to repair this construction at no cost to the Government. Pull pilings one sheet at a time. Pilings fused together shall be separated prior to pulling, unless the Contractor demonstrates, to the satisfaction of the Contracting Officer, that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

3.3.2 Sorting, Cleaning, Inventorying and Storing

Pulled pilings shall be sorted, cleaned, inventoried and stored by type into groups as:

- a. Piling usable without reconditioning.
- b. Piling requiring reconditioning.

c. Piling damaged beyond structural use.

3.4 INSTALLATION RECORDS

Maintain a [pile driving record](#) for each sheet pile. Indicate on the installation record: installation dates and times, type and size of hammer, rate of operation, total driving time, dimensions of driving helmet and cap used, blows required per foot for each foot of penetration, final driving resistance in blows for final 6 inches, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles. Record any unusual pile driving problems during driving. Submit complete records to the Contracting Officer.

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BITUMINOUS CONCRETE PAVEMENT FOR ROADS AND PATHWAYS

PART 1 GENERAL

1.1 SUMMARY

The work covered by this section of the specifications consists of furnishing all plant, labor, equipment and materials necessary to perform all operations in connection with application of a tack coat and construction of bituminous concrete pavement for roads and pathways. All work shall be performed in accordance with this section of the specifications and as shown on the contract drawings.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D977 (2005) Emulsified Asphalt

ASTM D2950/D2950M (2011) Density of Bituminous Concrete in Place by Nuclear Methods

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

State Specifications (1988) Standard Specifications for Highways and Bridges; Supplemental Specifications Dated June 6, 2006; Standard Special Provisions Dated November 20, 2007

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Mix Design; G, DO

The Contractor shall submit copies of the supplier's current job mix formulas at least ten working days prior to commencing any paving work.

SD-06 Test Reports

Test Results; G, DO

The Contractor shall submit the results of all laboratory and field tests.

SD-07 Certificates

Waybills and Delivery Tickets

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Concrete

Bituminous concrete for surface, binder, and base courses shall conform to the applicable requirements of Section 460 and Sections M3.01 and M3.11 of the [State Specifications](#) for Type I-1, Class I Bituminous Concrete Pavement.

2.1.2 Bituminous Concrete [Mix Design](#)

The bituminous concrete base course shall conform to the requirements listed in Table A of Section M3.11.03 of the [State Specifications](#) for Base Course.

The bituminous concrete binder course shall conform to the requirements listed in Table A of Section M3.11.03 of the [State Specifications](#) for Binder Course. The asphalt cement shall conform to the requirements listed in Table 2 of Section M3.01.0 of the [State Specifications](#) for viscosity Grade AC-20. The bituminous concrete surface course shall conform to the requirement listed in Table A of Section M3.11.03 of the [State Specifications](#) for Top Course.

Bituminous concrete for pathways and sidewalks shall conform to the requirement listed in Table A of Section M3.11.03 of the [State Specifications](#) for "Dense Mix".

The mixtures shall be obtained from a supplier regularly producing bituminous concrete under Section M3.11 of the [State Specifications](#). Approval shall be contingent on conformance of the completed pavement to the specification requirements, including adherence to the suppliers current job mix formulas within specific tolerance limits.

2.1.3 Tack Coat

Bituminous material used for the tack coat shall be emulsified asphalt conforming to [ASTM D977](#), grade RS-1.

PART 3 EXECUTION

3.1 PREPARATION OF EXISTING SURFACES

The surfaces to receive new bituminous concrete surface and binder courses shall be prepared as specified herein, prior to placement of the bituminous concrete surface and binder courses. The surface to receive new bituminous base course shall be prepared as specified in Section [31 00 00 EARTHWORK](#) prior to placement of any bituminous concrete base course.

3.2 TACK COAT

A tack coat shall be applied to the surface of the new base and binder

courses (vertical and horizontal) prior to construction of the new bituminous concrete surface/binder courses. Bituminous material for the tack coat shall be RS-1 emulsified asphalt conforming to [ASTM D977](#). The emulsion shall be applied at a rate of approximately 0.05 gallons per square yard. The underlying course shall be cleaned of all foreign matter and loose material, and shall be dry before the tack coat is placed. The temperature of the emulsion shall range between 75 degrees F and 130 degrees F at the time of application. The application shall be made just prior to placement of the bituminous concrete surface/binder courses and shall progress sufficiently ahead of the paving so that the surface to be paved will be "tacky".

3.3 BITUMINOUS CONCRETE PAVEMENT

Bituminous concrete pavement shall be constructed in accordance with the specified construction methods of Section 460 of the [State Specifications](#). Compaction, density, and joint requirements for this work are as stated in Paragraphs 460.64 and 460.65 of the [State Specifications](#).

3.3.1 Course Thickness and Density

The bituminous concrete base course shall be placed in one 4-inch thick layer, compacted. The bituminous concrete binder course shall be placed in one 2 inch thick layer, compacted. The bituminous concrete surface course shall be placed in one 2 inch thick layer, compacted. The density of the completed pavement shall not be less than 95 percent of the density obtained from laboratory compacted specimens of the same mixtures.

3.3.2 Weather Limitations

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 40 degrees F.

3.3.3 [Waybills and Delivery Tickets](#)

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in construction.

3.3.4 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to Subpart "Tack Coat". Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled is not permitted.

3.3.5 Steel Plates

Where steel plates are used to temporarily cover roadway areas any gaps that exist between the plate and the roadway surface shall be filled with cold patch material as specified in Section 472.4 of the [State Specifications](#).

3.4 BITUMINOUS CONCRETE WHEELCHAIR RAMPS

Bituminous concrete wheelchair ramps shall have detectable warning panels. Panels shall be "safety yellow" color. Panel construction shall conform to the "Construction Standards" detail M/E 107.6.5R "Detectable Warning Panel for Wheelchair Ramps".

3.5 JUNCTION OF BITUMINOUS CONCRETE PAVEMENT WITH OTHER TYPE PAVEMENTS

New bituminous concrete pavement shall meet other type pavements at locations shown. The existing pavement, including areas to be repaired, shall be saw cut (without overcut) to provide a neat vertical surface. All accidental overcuts shall be filled with bituminous joint sealer. The junction shall be neatly made to the satisfaction of the Contracting Officer. All edges of the existing pavement shall be coated with tack coat material prior to placement of any bituminous concrete pavement.

3.5.1 Patches

The standard cutback for all permanent pavement patches shall be 24 inches beyond the original pavement cuts made to perform the Contractors work. If curbing does not allow for 24 inches, then the curbing will serve as the edge of the permanent pavement patch. The pavement replacement thickness must match the existing pavement thickness or conform to the requirements for end state pavement, whichever pavement depth is greatest.

3.6 QUALITY CONTROL TESTING

3.6.1 General

Quality control testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Tests shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval of the Contracting Officer. Testing shall be repeated as necessary and as directed to ensure the required compaction is being achieved and that the materials are in compliance with the specifications. Areas improperly compacted or not meeting grade and smoothness requirements shall be removed and replaced at no additional cost to the Government.

3.6.2 Grade and Surface Smoothness Tests

Finished surface of bituminous courses, when tested as specified below and in Paragraph 460.67 of the [State Specifications](#), shall conform to grade lines and notes shown on the contract drawings and to surface-smoothness requirements specified. The grade of the completed surface shall not deviate more than 0.05 feet from the plan grade. The finished grades of each bituminous pavement course shall be surveyed at 25-foot intervals along the centerline and each edge of the roadway. When a 10-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge for the surface course and not more than 3/8 inch for the binder course. Measurements shall be made perpendicular to and across all bituminous pavement courses at intervals not to exceed 25 feet.

3.6.3 Laboratory and Field Density Tests

The densities of the completed pavement shall not be less than 95 percent

of the density obtained from laboratory compaction of a mixture composed of the same materials in like proportions. Laboratory compaction will be performed per the standard methods outlined in Sections 460.21 and M3.11 of the [State Specifications](#). Tests shall be performed in sufficient numbers to ensure that the specified field density is being obtained. A minimum of one set of laboratory tests shall be performed for each of the bituminous base, binder and top course mixtures used per 1000 tons of each mixture placed. A minimum of four field density tests performed in accordance with [ASTM D2950/D2950M](#) shall be performed on each 2000 square foot section of bituminous course constructed for each course placed. The tests shall be spaced to ensure quality compaction over all roadways and parking areas. The locations of the field density tests shall be approved by the Contracting Officer prior to performing the test.

3.6.4 Reporting [Test Results](#)

Copies of all laboratory and field tests shall be submitted to the Contracting Officer within 24 hours of completion of the test. The recording forms shall include all data collected, calculations, final test results, compaction equipment, number of passes, layer thicknesses, recommendations and changes made in the field based on the test results, the weather conditions, type and number of tests, test instrument calibration data, and any other pertinent data. The Contractor shall maintain current copies of the test reports at the project field office for the duration of the project.

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CONCRETE SIDEWALKS AND GRANITE CURBING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for
Burlap Cloth Made from Jute or Kenaf and
Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M (2007) Standard Specification for Steel
Welded Wire Reinforcement, Plain, for
Concrete

ASTM C171 (2016) Standard Specification for Sheet
Materials for Curing Concrete

ASTM C172 (2010) Standard Practice for Sampling
Freshly Mixed Concrete

ASTM C173/C173M (2016) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Volumetric Method

ASTM C231/C231M (2014) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Pressure Method

ASTM C309 (2011) Standard Specification for Liquid
Membrane-Forming Compounds for Curing
Concrete

ASTM C31/C31M (2015a; E 2016) Standard Practice for
Making and Curing Concrete Test Specimens
in the Field

ASTM C920 (2014a) Standard Specification for
Elastomeric Joint Sealants

ASTM D1751 (2004; R 2008) Standard Specification for
Preformed Expansion Joint Filler for
Concrete Paving and Structural
Construction (Nonextruding and Resilient
Bituminous Types)

ASTM D1752 (2004a; R 2013) Standard Specification for
Preformed Sponge Rubber Cork and Recycled
PVC Expansion

ASTM D5893/D5893M (2010) Cold Applied, Single Component,
Chemically Curing Silicone Joint Sealant
for Portland Cement Concrete Pavements

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

Construction Standards (1996) Construction and Traffic Details
(Metric Edition); Metric/English
Supplemental Drawings Dated April 2003

State Specifications (1988) Standard Specifications for
Highways and Bridges; Supplemental
Specifications Dated June 6, 2006;
Standard Special Provisions Dated November
20, 2007

THE COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF PUBLIC
SAFETY AND SECURITY CODE OF MASSACHUSETTS REGULATIONS (CMR)

521 CMR (2006) Architectural Access Board

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

28 CFR 36 App A (1994) Standards for Accessible Design

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for information only. When
used, a designation following the "G" designation identifies the office
that will review the submittal for the Government. The following shall be
submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in
the construction.

Detectable Warning Panels

SD-04 Samples

Detectable Warning Panels

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the
test.

SD-08 Manufacturer's Instructions

Detectable Warning Panels

Submit manufacturer's installation instructions.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.5 SIDEWALK AND RAMP CONSTRUCTION REQUIREMENTS

All sidewalk and ramp construction shall conform to the requirements of 521 CMR, 28 CFR 36 App A, and the Construction Standards.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE except as otherwise specified.

2.1.1 Reinforcement Steel

Wire mesh reinforcement shall conform to ASTM A185/A185M. Wire mesh reinforcement shall be 10 gauge wire with 6-inch by 6-inch squares. Only sheet mesh shall be used (no rolls).

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D1751 or ASTM D1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and

elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.7 GRANITE CURBING

The Contractor shall reuse existing granite curbing at the project to the maximum extent possible. New granite curbing shall conform to the applicable requirements of Sections 501 and M9.04.1 of the [State Specifications](#) for Type VA4 granite curbing, as approved by the Contracting Officer. New granite curbing shall be sized to match existing curbing.

2.8 DETECTABLE WARNING PANELS

Panels shall be precast concrete, cast-in-place concrete, or other suitable material permanently applied to a concrete wheelchair ramp. Panels on concrete ramps shall be a "brick" color. Panel construction shall conform to the [Construction Standards](#), M/E 107.6.5R "Detectable Warning Panel for Wheelchair Ramps" and M/E 107.2.1R "Wheelchair Ramp on Narrow Sidewalk".

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement as shown on the contract drawings.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms. Any fine grading of subgrade soils shall be done using Type C Gravel Borrow (2-inch maximum stone size) as specified in Section M1.03.0 of the [State Specifications](#).

3.1.2 Granite Curb Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curbing. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, edging operations shall be completed then the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and

then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 WHEELCHAIR RAMPS

The Contractor shall establish grade elevations at all wheelchair ramp locations, and shall set transition lengths according to the appropriate table in the [Construction Standards](#). All wheelchair ramp joints and transition sections which define grade changes shall be formed, staked, and checked prior to placing concrete. All grade changes shall be made at joints. Detectable warning panels shall be installed on all new or reconstructed wheelchair ramps.

3.4.1 Detectable Warning Panels

Detectable warning panels shall be installed on every wheelchair ramp as shown on the [Construction Standards](#), M/E 107.6.5R "Detectable Warning Panel for Wheelchair Ramps" and M/E 107.2.1R "Wheelchair Ramp on Narrow Sidewalk".

3.5 GRANITE CURB PLACEMENT AND FINISHING

The granite curbing shall be installed as shown on the contract drawings and constructed in accordance with the applicable portions of Section 501 of the [State Specifications](#).

3.5.1 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.5.2 Surface Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.6 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.6.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by

sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.6.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to [ASTM D1752](#) or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.6.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed. Wire mesh reinforcement shall be placed at mid-depth of the concrete sidewalk and shall rest on reinforcement "chairs" or cement concrete bricks spaced at 36-inch maximum in every direction to keep mesh from deforming during concrete placement.

3.7 GRANITE CURB JOINTS

Granite curb joints shall be constructed at right angles to the line of curb and gutter.

3.7.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.7.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb. Expansion joints shall be provided in curb directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type

and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit.

3.8 CURING AND PROTECTION

3.8.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.8.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.8.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.8.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be

resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.8.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.8.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.8.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.8.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.8.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50

degrees F.

3.9 FIELD QUALITY CONTROL

3.9.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.9.2 Concrete Testing

3.9.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with [ASTM C172](#). Cylinders for acceptance shall be molded in conformance with [ASTM C31/C31M](#) by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.9.2.2 Air Content

Air content shall be determined in accordance with [ASTM C173/C173M](#) or [ASTM C231/C231M](#). [ASTM C231/C231M](#) shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.9.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.9.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will

be determined by measuring each edge of the completed slab.

3.9.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.10 SURFACE DEFICIENCIES AND CORRECTIONS

3.10.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.10.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.10.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

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SECTION 32 17 24

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for pavement markings for road restoration. Temporary markings shall be paint only. Permanent markings shall include thermoplastic material and reflective media.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D792 (2013) Density and Specific Gravity
(Relative Density) of Plastics by
Displacement

ASTM E28 (2014) Softening Point of Resins Derived
from Naval Stores by Ring and Ball
Apparatus

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952 (Rev D) Paint, Traffic and Airfield
Markings, Waterborne

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G, RO

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for

use.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Sampling and Testing

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

1.5.1.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray

guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.1.2 Hand-Operated, Push-Type Machines

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.5.2 Thermoplastic Application Equipment

1.5.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.5.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.5.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable

applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.020 to 0.190 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

(1) The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle.

(2) The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thicknesses of not less than 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

1.5.3 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.5.4 Surface Preparation Equipment

1.5.4.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.5.4.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.5.5 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.5.5.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.5.5.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.5.6 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 MAINTENANCE OF TRAFFIC

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, police officers, as appropriate, and related equipment for the safe passage of vehicles shall be provided (see Section 01 55 26 TRAFFIC REGULATION).

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations,

except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

1.8 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for roads, parking areas, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads,	20 min.	20 min.
Calcium carbonate & inert fillers	49 max.	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated on the contract drawings.

2.2.2.2 Drying Time

When installed at 70 degrees F and in thicknesses between 1/8 and 3/16 inch, after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 194 degrees F when tested in accordance with [ASTM E28](#).

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with [ASTM D792](#).

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a [volatile organic compound \(VOC\)](#). Solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

2.3 [SAMPLING AND TESTING](#)

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits

shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Cleaning Existing Pavement Markings

Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans. Temporary markings shall be paint only. Permanent markings shall be thermoplastic material with reflective media.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet/gallon. Glass spheres shall be applied uniformly to the wet paint on road and street pavement at a rate of 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet/gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes.

Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265-400 square feet/gallon).

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch plus or minus 0.005 inch.

c. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound/20 square feet of compound.

3.2.3 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

3.3 MARKING REMOVAL

Pavement marking shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

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SECTION 32 31 13

CHAIN LINK FENCE AND GATE AND SECURITY FENCE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for four foot high chain link fence to be used for landscape protection at the locations shown on the contract drawings. Also covered is the security fence for the Boston Fire Alarm Headquarters. Temporary construction fencing is not covered by this section.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(2013) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2013) Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM C94/C94M	(2016a) Standard Specification for Ready-Mixed Concrete
ASTM F1043	(2016a) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F1083	(2016) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F567	(2014a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2014) Standard Specification for Fence

Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191/3

(Rev D) Fencing, Wire and Post, Metal
(Chain-Link Fence Posts, Top Rails and
Braces)

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G, DO

Security Fence; G, DO

Location of Gate, Corner, End, and Pull Posts; G, DO

Gate Assembly; G, DO

Gate Hardware and Accessories; G, DO

Submit Erection/Installation Drawings for the above items.

SD-03 Product Data

Fence Assembly

Security Fence; G, DO

Gate Assembly

Gate Hardware and Accessories

Submit manufacturer's catalog data for the above items.

SD-07 Certificates

Zinc Coating

PVC coating

Submit Certificates of Compliance in accordance with the applicable reference standards and descriptions of this section for the above items.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 SECURITY FENCE

The Contractor shall supply and install new security fence, required for the Boston Fire Alarm Headquarters, to match the existing security fence currently installed and requiring removal or to remain. Installation shall be as shown on the contract drawings and in accordance with the fence manufacturer's recommendations.

All other requirements of this section pertain to chain link fence materials and installation for the landscape protection fence.

2.2 GENERAL

Provide fencing materials that conform to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

2.3 ZINC COATING

Ferrous-metal components and accessories, except as otherwise specified, shall be hot-dip galvanized after fabrication. Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating that conforms to the requirements of the following:

Pipe: FS RR-F-191/3 Class 1, Grade A in accordance with ASTM F1083.

Hardware and accessories: ASTM A153/A153M, Table 1.

Surface: (ASTM F1043).

External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.4 FABRIC

Fabric shall consist of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, ASTM A702 and ASTM F626, with 1.29 ounces per square foot zinc galvanizing. Fence shall have one-piece fabric width.

2.5 PVC COATING

Fabric shall be polyvinyl chloride (PVC) coated over zinc galvanizing. Color of PVC coating shall be black.

2.6 TOP AND BOTTOM SELVAGES

Fabric shall be knuckled on the top and bottom selvage.

2.7 LINE POSTS

Line posts shall be 2.0-inch O.D. pipe weighing 3.65 pounds per linear foot.

2.8 END, CORNER, AND PULL POSTS

End, corner, and pull posts shall be Grade A; 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

2.9 TOP AND BOTTOM RAIL

Rails shall be a minimum of 1.660 inches O.D. pipe Grade A, weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in rails.

2.10 POST-BRACE ASSEMBLY

Bracing shall consist of 1.660 inches O.D. pipe, Grade A weighing 2.27 pounds per linear foot.

2.11 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with [ASTM A116](#), [ASTM A702](#) and [ASTM F626](#).

2.12 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post. Caps shall have an opening to permit through passage of the top rail.

2.13 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.14 GATE POSTS

Provide a gate post for supporting each gate leaf as follows: 2.875 inch O.D. pipe, Grade A weighing 5.79 pounds per linear foot.

2.15 GATES

Perimeter gate frames shall be 1.66 inch O.D. pipe, Grade A weighing 2.27 pounds per linear foot. Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, shall be provided where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

Gate access and location will be such that adjacent paths are not blocked.

2.16 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conform to ASTM A116, ASTM A702, ASTM F626, and as specified herein. Provide malleable iron, forged steel, or pressed steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening. Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch. Provide stops and holders of malleable iron. Provide two four number combination locks at each gate location.

2.17 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.18 WIRE TIES

Wires for tying fabric to line posts shall be 16-gage galvanized steel wire spaced 12 inches on center. For tying fabric to rails and braces, wire ties shall be spaced 24 inches on center. For tying fabric to tension wire, 0.105-inch hog rings shall be spaced 24 inches on center. Manufacturer's standard procedure will be accepted if of equal strength and durability. Provide wire ties constructed of the same material as the fencing fabric. Provide accessories with polyvinyl (PVC) coatings similar to that specified for chain-link fabric and framework.

2.19 COLOR FOR POSTS, RAILS AND ASSOCIATED ITEMS

Posts, rails and associated items shall have a black painted finish to match the black PVC coating of the fence fabric. The black finish shall be as recommended by the fence manufacturer.

2.20 CONCRETE

Provide concrete conforming to ASTM C94/C94M. Concrete mix shall obtain a minimum 28-day compressive strength of 3,000 psi.

PART 3 EXECUTION

Completed installation shall conform to ASTM F567.

3.1 GENERAL

Final grading and established elevations shall be complete prior to commencing fence installation.

3.2 EXCAVATION

Excavations for post footings shall be drilled holes in soil. Space footings for line posts 10 feet on center maximum. Bottoms of the holes shall be approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads. Soil from excavations shall be removed from the work sites.

When solid rock is encountered near the surface, the Contractor shall drill

into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least one inch greater in diameter than the largest dimension of the placed post. If solid rock is below the soil overburden, the Contractor shall drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Gate, corner, and pull posts shall be set in concrete. Line posts shall be driven. For posts to be set in concrete, remove loose and foreign materials from holes and moisten the soil prior to placing concrete. Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material.

3.3.1 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member.

3.4 CONCRETE STRENGTH

Provide Concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Fabric and wires shall not be stretched or gates hung until the concrete has attained its full design strength.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 BRACE ASSEMBLY

Contractor shall provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric. Install brace assemblies so posts are plumb when the diagonal rod is under proper tension. Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.7 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom knuckles placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts and rails with wire ties and bands. Fabric shall remain under tension after the pulling force is released.

3.8 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.9 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

3.10 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.11 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.12 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.13 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.14 SITE PREPARATION

3.14.1 Grading

Establish a graded, compacted fence line prior to fencing installation.

3.15 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.15.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.16 ACCESSORIES INSTALLATION

3.16.1 Post Caps

Design post caps to accommodate top rail. Install post caps as recommended by the manufacturer.

3.17 CLEANUP

Remove waste fencing materials and other debris from the work sites.

3.18 REMOVAL

Landscape protection fences, including posts and concrete footings, shall be removed at the completion of the plant guarantee period as defined in Section 32 93 00 EXTERIOR PLANTING AND HABITAT RESTORATION.

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SECTION 32 84 24

COIR LOGS

PART 1 GENERAL

1.1 COIR LOG STRUCTURES

The Contractor shall furnish and install coir logs, stakes, ropes, and related items as shown on the contract drawings. Coir logs and related items shall be properly installed to effectively prevent erosion. All components shall be 100 percent biodegradable and shall not be removed at the completion of the work.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Material Data Sheets; G, RO

The Contractor shall submit material data sheets from the respective manufacturer's for the coir logs, stakes, and rope proposed for use in constructing the containment structures.

SD-04 Samples

Coir Logs; G, RO

The Contractor shall submit a sample coir log, a minimum length of three feet, proposed for use in constructing the containment structures.

Timber Stakes; G, RO

The Contractor shall submit a sample stake, a minimum of six feet long, proposed for use in constructing the containment structures.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in an undamaged condition in the manufacturer's original packaging. Coir logs as delivered shall be wrapped in plastic. Store materials off the ground and maintain original packaging until items are installed to provide protection against deterioration prior to installation.

PART 2 PRODUCTS

2.1 COIR LOGS

Coir Logs shall consist of machine fabricated cylinders consisting of 100 percent coconut fiber encased in a high tensile machine spun bristle coconut coir fiber twine with a minimum tensile strength of 80 pounds. The unit weight of the coir logs shall be no less than seven pounds per cubic foot. Minimum length of the coir logs shall be 10 feet, maximum 20 feet. Diameter of the coir logs shall be no less than 12 inches. Outer netting shall be constructed from three ply high strength coir twine or yard. The average breaking strength of the coir twine or yarn shall be a minimum of 90 pounds. Minimum diameter of the twine or yarn shall be 3/8 inch. All components of the log shall be 100 percent biodegradable. Both ends of the coir logs shall be reinforced with additional coir twines and flat ends for better joints.

2.2 TIMBER STAKES

Timber stakes shall be fabricated from non-treated wood. Stakes may be tapered, but shall maintain a minimum of three inches in diameter throughout the length of the stake with a notch to secure rope ties.

2.3 BIODEGRADEABLE ROPE

The Contractor shall use a solid braid 100 percent biodegradable rope to tie down coir logs.

PART 3 EXECUTION

3.1 INSTALLATION OF COIR LOGS AND STAKES

Coir logs shall be located along the excavated banks to meet the required alignments, as shown on the contract drawings. The coir logs shall be placed one high tightly together with no gaps as needed to meet the required installation shown on the contract drawings. The coir logs shall be installed between rows of stakes and pushed down snug to the final constructed earth surface. Additionally, the coir log shall be compressed slightly by applying down pressure before installation of the tie down rope between the stakes, or by driving the stakes deeper after the rope is tied on. Coir logs shall be tightly laced end to end and secured to the stakes using a solid braid biodegradable rope. The rope shall be tightly stretched between the top of the stakes and firmly secured.

Stakes shall be provided continuously on both sides of the stacked coir logs and opposing one another, at four feet on center. The embedment depth of wood stakes into the pond bottom shall have a minimum embedment depth of four feet. For aesthetic purposes, the top of the stake shall be flush with the top of the coir log.

3.2 MAINTENANCE

Coir logs are considered temporary structure to contain soil during consolidation and plant establishment, and some movement of the logs is expected to occur. However, this movement and instability shall be kept within reasonable limits by the Contractor to prevent failure.

The Contractor shall maintain the coir logs in good and effective operating condition by performing routine inspections to determine condition and

effectiveness, and by restoration of damaged or settled coir logs, stakes,
and braided rope.

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SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

This section specifies seeding for areas to be restored and maintained by seeding. Areas to be planted with trees and shrubs shall be planted as specified in Section 32 93 00 EXTERIOR PLANTING.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C602 (2007) Agricultural Liming Materials

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Watering Plan; G, DO

A plan describing how seeded areas will be watered during the establishment and guarantee period.

SD-03 Product Data

Wood Cellulose Fiber Mulch; G, DO

Fertilizer; G, DO

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil Composition Tests; G, DO

Reports and recommendations.

SD-07 Certificates

Seed; G, DO

State certification and approval for seed.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.4.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.4.2 Storage

1.4.2.1 Seed, Fertilizer, and Lime Storage

Store in cool, dry locations away from contaminants.

1.4.2.2 Topsoil

See Section 32 93 00 EXTERIOR PLANTING.

1.4.2.3 Handling

Do not drop or dump materials from vehicles.

1.5 RESTRICTIONS

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 80 degrees Fahrenheit.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer. Requirements for guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material do not apply to the Wetland Seed Mix and Native Grass and Wildflower Mix.

2.1.2 Planting Dates

Planting dates shall be 30 August through 1 October and 15 April through 1 June. Dormant seeding of the Wetland Seed Mix and Native Grass and Wildflower Mix is permitted followed by installation of temporary erosion controls such as straw or hydromulch in sloped areas.

2.1.3 Seed Mixtures

Sun and Shade Mix:

<u>Seed</u>	<u>Proportion</u>	<u>Germination Minimum</u>	<u>Purity Minimum</u>
Boreal Red Fescue	30%	85%	95%
Merit Kentucky Bluegrass	25%	90%	90%
Affinity Perennial Ryegrass	28%	90%	90%
Stallion Perennial Ryegrass	17%	90%	90%

Dense Shade Mix:

<u>Seed</u>	<u>Proportion</u>	<u>Germination Minimum</u>	<u>Purity Minimum</u>
Koket Chewings Fescue	30%	85%	95%
Affinity Perennial Ryegrass	20%	90%	90%
Patriot II Perennial Ryegrass	20%	90%	90%
Pennlawn Red Fescue	20%	85%	90%
Boreal Red Fescue	10%	85%	95%

Native Grass and Wildflower Mix:

<u>Seed</u>	<u>Proportion</u>
Creeping Red Fescue (Festuca rubra)	15%
Little Bluestem (Schizachyrium scoparium)	15%
New England Aster (Aster novae-angliae)	5%
Grass Leaved Goldenrod (Euthamia graminifolia)	10%
Deer Tongue (Panicum clandestinum)	10%
Early Goldenrod (Solidago juncea)	10%
Canada Wild Rye (Elymus Canadensis)	10%
Virginia Wild Rye (Elymus virginicus)	10%
White Wood Aster (Aster divaricatus)	5%
Wild Senna (Senna marilandica)	10%

Wetland Seed Mix: New England Wetland Plants "New England Wetmix" or equivalent wetland seed mix, approved by the Contracting Officer.

Temporary Seed Mix: As approved by the Contracting Officer, the Contractor may use winter rye, annual rye, riverbank wild rye, buckwheat, or red clover as a temporary cover to control erosion.

Seed may be mixed by an approved method on the site or may be mixed by a dealer. If the seed is mixed on site, each variety shall be delivered in the original containers, which shall bear the dealer's guaranteed analysis. If a dealer mixes the seed, the Contractor shall furnish to the Contracting Officer the dealer's guaranteed statement of the composition of the mixture.

2.2 TOPSOIL

See Section 32 93 00 EXTERIOR PLANTING.

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602 of not less than 80 percent, ground so that 50% will pass a 100 mesh sieve and 90% will pass a 20 mesh sieve.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients, but shall be adjusted as recommended by the soil analysis:

- 5 percent available nitrogen
- 10 percent available phosphorus
- 5 percent available potassium

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients.

- 5 percent available nitrogen
- 10 percent available phosphorus
- 5 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Wood Cellulose Fiber Mulch (Hydromulch)

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life. Water shall not be taken from the Fens or Riverway.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the requirements listed in Section 32 93 00 EXTERIOR PLANTING

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), aeration-decompaction, fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 6 inches of topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, and soil conditioners into soil a minimum depth of 3 inches by harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Soil testing shall be conducted as described in Section 32 93 00 EXTERIOR PLANTING AND HABITAT RESTORATION

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following: Lime 1000 pounds per acre. Apply lime only to areas designated as "seed" on the project drawings.

3.1.1.3 Initial Fertilizer Application Rates

Apply initial fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following: 200 pounds per acre. Apply fertilizer only to areas designated as "seed" on the project drawings.

3.2 SEEDING

The restoration specialist shall determine and mark with stakes any area to receive the "Dense Shade Mix". All other areas shall receive the "Sun and Shade Mix". Areas planted with trees and shrubs shall be seeded with the "Grass and Wildflower Seed Mix". Wetland areas shall be seeded with the "Wetland Seed Mix".

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered, or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by

approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

3.2.2.1 Seed Areas

Seeding method shall be hydroseeding.

3.2.2.2 Areas planted with Trees and Shrubs

Broadcast seed areas protected by turf reinforcement matting (preferably prior to installation of matting). All other areas shall be hydroseeded. Do not seed mulched areas.

3.2.2.3 Wetland Areas

Broadcast seed by hand as per manufacturer's recommendations.

3.2.3 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,200 to 1,500 pounds per acre, dry weight, for slopes of 2.5:1 or flatter, and 1,500 to 2,000 pounds per acre, dry weight, for slopes steeper than 2.5:1. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed shall be mixed to ensure broadcasting at the required rate. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch. Do not coat trees and shrubs with hydromulch.

3.2.4 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.2.5 Seeding Rate

Lawn areas (Sun and Shade Mix or Dense Shade Mix): 10 pounds per 1000 square feet. The restoration specialists shall choose which mix to use based on site conditions.

Areas planted with Trees and Shrubs (Native grass and Wildflower Mix): 18 lbs/per acre.

3.3 MAINTENANCE DURING ESTABLISHMENT PERIOD

The establishment period shall extend until September 15 in the calendar year following provisional acceptance of seeded areas.

Maintenance of seeded areas shall extend until September 15 in the calendar year following provisional acceptance of seeded areas outside the landscape protection fence. In the areas inside the landscape protection fence, maintenance of seeded areas shall extend until final acceptance of exterior plantings is issued by the Contracting Officer.

Maintenance of areas seeded with the Native Grass and Wildflower Mix shall extend until final acceptance of exterior plantings is issued by the Contracting Officer pursuant to Section 32 93 00 EXTERIOR PLANTING AND HABITAT RESTORATION. Maintenance of areas seeded with the Wetland Seed Mix shall extend until September 15 in the calendar year following provisional acceptance of seeded areas, or until 75 percent cover of native wetland vegetation is obtained (if later).

3.3.1 Lawn Areas

Maintenance shall begin immediately after any area is seeded and shall continue until final written acceptance of the lawn by the Contracting Officer. Maintenance shall include reseeding, mowing, watering, weeding, pest control, liming, trash removal, leaf removal, and fertilization. The Contractor shall remove leaves that accumulate inside and along the outside of the landscape protection fencing biweekly in the fall (September, October, November) and spring (April). Remove trash from seeded areas every two weeks from March 15 through November 15.

3.3.1.1 Watering

The Contractor shall water as required to establish an acceptable lawn within the establishment period. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week after seeding to maintain moist soil to a depth of at least 3 inches as indicated by a soil moisture meter. In subsequent weeks, the Contractor shall water the lawn as required to maintain moisture in the upper three inches of soil necessary for normal growth.

Watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to lawn areas or other plantings by watering equipment. Water shall be provided by water trucks. Water from hydrants may be available, with written approval from the relevant authority. Prevent damage to plantings, pathways, and completed areas of work with watering equipment.

3.3.1.2 Reseeding

After the grass in seeded areas has germinated, all areas and parts of areas which, in the opinion the Contracting Officer, fail to show a uniform stand of grass shall be reseeded by the Contractor.

3.3.1.3 Mowing

The Contractor shall keep lawn areas mowed until written acceptance of the seeding by the Contracting Officer. The lawn shall be cut to a height of two inches (2") when growth reaches three inches (3"), or as directed by the Contracting Officer. Mowing shall include mulching of clippings into the lawn. Litter shall be removed prior to mowing. Frequency of mowing shall be determined by the Contracting Officer based on time of year and condition of seeded areas.

3.3.1.4 Fertilizing

Fertilizer shall be applied at the rate of 30 lbs/1,000 square feet in April or May after the first growing season.

3.3.1.5 Liming

Liming shall be required if soil analysis indicates it is required to bring the soil pH to above 6.0

3.3.1.6 Weed, Disease, and Pest Control

Any chemical application for control of weeds, pests, or diseases, must conform to permits issued by the Boston and Brookline Conservation Commissions and MA DEP. The proposed chemical(s) (including product literature), the timing of control, and method of application of chemicals shall be submitted to the Contracting Officer in writing for approval. No material or method of application shall be employed at the site until the Contracting Officer has granted written approval. Areas seeded with the native grass and wildflower mix shall be protected from drift or runoff of weed control chemicals applied to adjacent lawn areas. Any non-target vegetation damaged by weed control chemicals shall be restored at no cost to the Government.

3.3.1.7 Protection of Seeded Areas

It is the responsibility of the Contractor to protect seeded areas from damage from foot and vehicular traffic prior to final acceptance by the Contracting Officer. No additional compensation will be provided to the Contractor for reseeding or protection efforts required for proper establishment of the seeded areas.

3.3.2 Areas Seeded with the Native Grass and Wildflower Mix

Water as specified in Subpart "Watering" and monitor seeded areas for compliance with performance standards. Reseed areas where less than 50 percent cover of herbaceous vegetation is not obtained after one growing season. Do not coat trees or shrubs with hydromulch during reseeding. Control invasive plants pursuant to Section 32 94 00 INVASIVE PLANT CONTROL. Remove by hand pulling noninvasive plants that degrade aesthetics or threaten to impede growth of planted shrubs. These include mugwort, common mullein, hawkweed, burdock, pokeweed, and other species, as directed by the Contracting Officer.

3.3.3 Wetland Areas and Banks Seeded with Wetland Seed Mix

Control invasive plants pursuant to Section 32 94 00 INVASIVE PLANT CONTROL.

3.4 PERFORMANCE STANDARDS

3.4.1 Seed Areas

A healthy stand of grass shall be established at the end of the 12 month Establishment Period. The stand shall be substantially free of weeds (less than 2 percent cover) and contain no bare areas larger than two (2) square feet. Soils shall be stabilized and free of erosion.

3.4.2 Areas Seeded with the Native Grass and Wildflower Mix

Minimum 50 percent cover of native grasses and wildflowers at the end of the 12 month Establishment Period (excluding mulched areas). Seeded areas shall also be free of oriental knotweed, Phragmites, and other invasive species, and noninvasive plants determined by Contracting Officer to degrade aesthetics or threaten to impede growth of planted shrub.

3.4.3 Areas Seeded with Wetland Seed Mix (Treatment E)

Seventy-five (75) percent cover by native wetland (OBL, FAC, or FACW) species, including species in the wetland seed mix and volunteers.

3.5 Inspection and Approval

3.5.1 Initial Inspection

Following completion of seeding in each area, the Contractor, Landscape Architect, and Contracting Officer shall inspect the seeded areas. If plant materials and workmanship are acceptable, written notice will be given by the Contracting Officer to the Contractor stating that the work has received provisional acceptance and that the Establishment Period shall commence. The establishment period shall extend until September 15 in the calendar year following provisional acceptance.

3.5.2 Final Inspection

Following completion of the Establishment Period, the Contractor and Contracting Officer, with representatives of the the Conservation Commissions of Boston and Brookline, shall inspect the seeded areas. If the plant material and workmanship are acceptable, written notice of final acceptance will be given by the Contracting Officer. If remedial action is required to meet performance standards, the Contracting Officer will extend the Establishment Period until performance standards are met. Final inspection and approval of areas seeded with the Native Grass and Wildflower Mix shall coincide with the final acceptance of exterior plantings.

-- End of Section --

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DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 93 00

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SECTION 32 93 00

EXTERIOR PLANTING AND HABITAT RESTORATION

PART 1 GENERAL

1.1 SUMMARY

This section specifies the requirements for landscape and habitat restoration, and turf reinforcement mats (TRM). This section includes specifications regarding topsoil, plant material, planting, habitat enhancement features, post landscape maintenance, and performance criteria.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

ANSI Z133 (2006) Arboricultural Operations - Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush

ANSI Z60.1 (1996) Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM C602 (2007) Agricultural Liming Materials

ASTM D4972 (2001; R 2007) Standard Test Method for pH of Soils

ASTM D5268 (2007) Standard Specification for Topsoil Used for Landscaping Purposes

L.H. BAILEY HORTORIUM

LHBH (1976) L.H. BAILEY HORTORIUM, Hortus Third

THE COMMONWEALTH OF MASSACHUSETTS

MCP RCS-1 The Massachusetts Contingency Plan Reportable Concentration for the Soil 1 (Category MCP RCS-1)

1.3 RELATED REQUIREMENTS

Related requirements can be found in Section 31 00 00 EARTHWORK, Section 32 94 00 INVASIVE PLANT CONTROL, Section 32 92 19 SEEDING, and Section 01 57 20 ENVIRONMENTAL PROTECTION.

1.4 QUALIFICATIONS

1.4.1 Habitat Restoration Specialist

Habitat Restoration shall be supervised by an individual with at least five years experience successfully supervising complex riparian or wetland habitat restoration projects.

1.4.2 Arborist

Tree removal, tree protection, and pruning shall be supervised by a Massachusetts Certified Arborist, who is present on the project site while work is being performed.

1.4.3 Landscape Architect

Selection, installation, and maintenance of trees and shrubs shall be supervised by a Massachusetts Licensed and Registered Landscape Architect. The Landscape Architect shall have at least 5 years experience supervising historic landscape restoration.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Habitat Restoration Specialist; G, DO

The Contractor shall submit a resume summarizing the professional qualifications, including education and experience, of the proposed habitat restoration specialist. A brief description of historic landscape restoration projects supervised by the person during the past five years shall be provided as an attachment. The project description shall include the project name, location, size, and for at least two projects, the name, phone number, and email address of a client reference.

Arborist; G, DO

The Contractor shall submit a resume summarizing the professional qualifications, including education and experience, of the proposed certified Arborist.

Landscape Architect; G, DO

The Contractor shall submit a resume summarizing the professional qualifications, including education and experience, of the proposed Landscape Architect. A brief description of historic landscape restoration projects supervised by the person during the past five years shall be provided as an attachment. The project description shall include the project name, location, size, and for at least two projects, the name, phone number, and email address of a client reference.

Work Plan; G, DO

The Contractor shall submit for approval a work plan describing how all work of this section will be accomplished. The work plan shall, as a minimum, include the following:

- a. Contract drawings showing the required location of all plantings and the quantity of plant material required for each species or variety.
- b. Proposed source(s) of all required plant material.
- c. Plan for storage and maintenance of plant material while it is on-site prior to installation.
- d. Design, installation, and maintenance of fencing, including fencing to protect landscaped areas during the establishment period and herbivore exclusion fencing.
- e. Proposed source(s) and testing of topsoil and compost.
- f. Proposed type and source erosion control blanket.
- g. Proposed source(s) for mulch.
- h. Proposed measures to protect existing trees, shrubs, turf, and other landscape features to be preserved within the construction area.
- i. Plan for storage and handling of topsoil and mulch.
- j. Plan for installation of habitat logs and boulders.
- k. Proposed source, size, and composition of habitat boulders.
- l. Plan for watering seeded areas and planted material.
- m. Plan to salvage and store habitat logs during site clearing.
- n. Plant installation plan, including measures to assure that plant material is installed at proper location and elevation. Proposed plant installation schedule.
- o. Summary of invasive plant species control plan (See Section 32 94 00 INVASIVE PLANT CONTROL)
- p. Site maintenance and monitoring during the plant establishment period. Items to discuss include erosion control, watering, fertilization, invasive species control, weeding, herbivore control, fencing, tree protection, pruning, mowing schedule for grassed areas, trash removal, leaf removal, plant material performance standards, and schedule for replacement of failed plant material.
- q. QC/GA plan for assuring quality of topsoil, correct installation of erosion control matting, plant material quality and quantity, correct installation of the plant material, and invasive plant control.

r. Names, affiliations, contact information (phone numbers and email address) of the restoration specialist(s), nursery manager(s), arborist(s), licensed pesticide applicator(s), and other key personnel involved in site restoration activities.

SD-03 Product Data

Turf Reinforcement Mat; G, DO

Turf Reinforcement Mat Staples; G, DO

Mulch; G, DO

Fertilizer; G, DO

SD-04 Samples

Mulch; G, DO

2-gallon sample required.

SD-06 Test Reports

Topsoil; G, DO

Leaf Compost; G, DO

Nursery Certifications; G, DO

Condition Report

1.6 QUALITY ASSURANCE

1.6.1 Topsoil Composition Tests

1.6.1.1 Physical Soil Properties and Fertility

Commercial test from an independent testing laboratory including grain size (ASTM D5268 organic matter (loss on ignition)), Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations of soil to the project site. One sample shall be tested for each 300 cubic yard of topsoil installed on site. If leaf compost is required as an amendment to meet specified organic matter criteria, test soil after addition of the leaf compost.

1.6.1.2 Contaminants

Commercial test from an independent testing laboratory for analytes listed in Massachusetts Contingency Plan for the upland soil category (MCP RCS-1). One sample shall be tested for each 2,000 cubic yards of topsoil installed on site. If leaf compost or other soil amendments are required as an amendment to meet specified organic matter criteria, test soil after addition of the soil amendment.

1.6.2 Nursery Certification

Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.

1.7 SOURCE INSPECTIONS

1.7.1 Plant Materials

Plant materials shall be subject to inspection at the growing site by the Contracting Officer.

1.7.2 Topsoil and Soil Amendments

The source of the topsoil and soil amendments (leaf compost) shall be subject to inspection and approval by the Contracting Officer.

1.8 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.8.1 Shipment and Delivery

1.8.1.1 Protection of Plant Material During Shipment

Plant material shall be protected during shipment and delivery to prevent desiccation and damage to trunks, roots, branches, stems, and leaves. Deliver trees with exposed branches covered with material which allows air circulation. Ship rhizomes and bulbs in insulated containers to prevent overheating during shipment.

1.8.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to State and Federal laws.

1.8.1.3 Delivery Schedule

The nursery shall confirm availability of plant material three (3) month prior to anticipated delivery. Requests for substitutions must be submitted to the Contracting Officer for approval at least three weeks prior to delivery. The watering system shall be in place prior to delivery.

1.8.2 Inspection

Plants and materials shall be inspected by the Contracting Officer and Landscape Architect upon arrival at the job site for conformity to type and quality in accordance with these specifications. Unacceptable materials shall be removed from the job site and replaced at no additional cost to the Government.

1.8.2.1 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 120 days after delivery to the planting site.

1.8.3 Storage

1.8.3.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

- a. Shade and protect plants in outside storage areas from wind and direct sunlight until planted.
- b. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, wood chips, shredded bark, or other approved material. Provide covering which allows air circulation.
- c. Keep plants in a moist condition until planted by watering with a fine mist spray. The watering system shall be in place prior to delivery.
- d. Store rhizomes and bulbs in cool, dark area with ventilation. Store on-site no longer than 3 days prior to planting and prevent desiccation.

1.8.3.2 Topsoil, Leaf Compost, Mulch, Soil Amendments (Fertilizer and lime)

Store in dry location away from contaminants. Stockpile in outdoor location as directed by the Contracting Officer. Install erosion controls to prevent runoff from topsoil or leaf compost from reaching surface waters.

1.8.4 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle balled and burlapped and container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Do not dislodge plugs from containers and avoid damaging leaves. Be careful not to damage buds on bulbs and rhizomes. Damaged materials shall be removed from the job site and replaced at no additional cost to the Government.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 General

Furnish nursery stock in accordance with ANSI Z60.1, except as otherwise specified or indicated. Furnish plants grown under climatic conditions similar to those in the locality of the project. To the extent practicable, plant material shall derive from stock native to the northeastern United States, plant zones 5 and 6. Plants of the same specified size shall be of uniform size and character of growth. Plants shall comply with all Federal and State Laws requiring inspection for plant diseases and infestation. No trees or shrubs shall be obtained from nurseries located within areas regulated by state or Federal agencies to suppress and control the Asian Longhorned Beetle.

2.1.2 Substitutions

Plant material shall be provided as indicated in the approved work plan and

drawings. Substitutions will not be allowed without written request and approval from the Contracting Officer. Requests for substitutions shall be submitted to the Contracting Officer for approval at least three weeks prior to delivery.

2.1.3 Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, and abrasion and having a healthy, normal, and undamaged root system. All balled and burlapped and container grown root balls shall conform to [ANSI Z60.1](#). Root growth in container grown plants shall be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.3.1 Trees

Well-branched, well formed, sound, vigorous planting stock free from disease, sunscald, windburn, abrasion, and free from objectionable disfigurements. Branching shall be typical in relationship to the size and species of tree specified and with the crown in good balance with the trunk. Single stem: the trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader. Multi-stem: all countable stems, in aggregate, shall average the size specified.

2.1.3.2 Shrubs

Vigorous, healthy plants having healthy and well-branched root systems shall be provided. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project. If in leaf, plants shall be free from disease with no leaf damage, chlorosis, wilting, insect damage, sun-scald injury, or broken branches. If dormant (without leaves), stems shall be pliable and exhibit healthy (light green to yellowish green) cambium. Plants with brittle stems, unhealthy cambium, or broken branches will not be accepted.

2.1.3.3 Container Grown Emergents (Plugs)

Plugs shall have a root mass of at least two inches in diameter at the root crown. The plug shall be grown in a peat pot or other container sufficiently long for new fibrous roots to have rooted throughout the pot. The root mass shall retain its shape and hold together when removed from the container. Leaves and stems shall appear healthy with no significant leaf damage, discoloration, chlorosis, wilting, or evidence of insect damage.

2.1.3.4 Container Grown Herbaceous Plants

Plants shall be free from disease with no leaf damage, chlorosis, or wilting, and no insect damage, or sun-scald injury. Acceptable plant material shall be well shaped, and recognized by the trade as typical for the species grown in the region of the project.

2.1.4 Size

Minimum sizes measured after pruning and with branches in normal position, shall conform to measurements indicated, based on the average width or height of the plant for the species as specified in [ANSI Z60.1](#). Plants larger in size than specified may be provided with approval of the

Contracting Officer. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

2.2 Topsoil

2.2.1 Source

Topsoil may be obtained on-site (reuse) or obtained from off-site. Existing topsoil may be stripped and stockpiled on-site for reuse in accordance with Section 31 00 00 EARTHWORK. On-site top soil may be modified to conform to the requirements specified for topsoil in Subpart entitled "Composition". Topsoil originating off-site must conform to requirements specified in paragraph entitled "Composition".

2.2.2 Composition

Evaluate soil for use as topsoil in accordance with ASTM D5268. The pH shall be tested in accordance with ASTM D4972. Topsoil shall be free of sticks, stones, roots, concrete, asphalt, bricks, glass, and other debris and objectionable materials. Other parameters shall conform to the following limits, unless otherwise approved by Contracting Officer:

<u>Parameter</u>	<u>Range</u>
Silt (0.002-0.05mm)	15 to 30 percent
Clay (< 0.002 mm)	5 to 15 percent
Sand (0.05 - 2.0 mm)	60 - 75 percent
> 1/4 inch	< 3% by volume
> 3/4 inch	< 1% by volume
> 2 inch	none
pH	6.0 to 7.0
Soluble Salts	< 75 parts per million
Organic matter	6 to 12 percent (loss on ignition)
Contaminants	Concentrations not to exceed MCP RCS-1 levels

2.2.3 Adjustments

The composition of off-site soil may be adjusted to meet composition requirements by adding compost or inorganic components prior to delivery to the site. On-site topsoil or subsoil may be adjusted on-site to meet topsoil composition requirements with approval of the Contracting Officer. The amended or manufactured topsoil shall be thoroughly mixed and tested to assure it meets criteria in Subpart "Composition".

2.2.4 Lime

Commercial grade limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602 of not less than 80 percent, ground so that 50% will pass a 100 mesh sieve and 90% will pass a 20 mesh sieve.

2.2.5 Fertilizer

Granular commercial fertilizer containing nitrogen, phosphorus, and potassium. The formulation shall meet recommendations of soil analysis and be approved by the Contracting Officer.

2.2.6 Slow Release Fertilizer

15-9-12 or approved equal slow release fertilizer designed to provide for

the continuous release of nutrients for at least 18 months.

2.2.7 Compost

Compost shall be derived from organic wastes including leaf and yard residues, and biosolids that meet all State Environmental Agency requirements. The product shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth. Compost shall have the following properties:

<u>Parameter</u>	<u>Range</u>
pH	5.5 - 8.0
Moisture Content	35% - 55%
Soluble Salts	< 4.0 mmhos (dS)
C:N Ratio	15 - 30:1
Particle Size	< 3/4 inch
Organic Matter Content	>20%
Bulk Density	< 1200 lbs./cubic yard
Foreign Matter	< 1% (dry weight)

2.2.8 Mulch

Pine bark aged a minimum of six months. The mulch shall be dark brown in color, free of chunks and pieces thicker than 1/2-inch and shall not, in the judgment of the Contracting Officer, contain an excess of fine particles.

2.2.9 Turf Reinforcement Mat

The turf reinforcement mat (TRM) shall be 100 percent coir and not a mixture of coir and straw. The TRM shall contain no polypropylene netting. The TRM shall have a minimum life expectancy of 18 months. The weave shall be at 0.5 inches or larger and shall not exceed 0.75 inches in size. Interwoven strands of the netting shall move independently to minimize risk of wildlife entrapment. The weight of the TRM shall be between 500 and 800 grams per square meter. The TRM shall be rated for protection of slopes up to 2H:1V and for river velocities of at least 8 feet/sec along the slope above the normal water level. Pins or staples shall be used to secure the TRM in position and shall be 100 percent biodegradable and a minimum of four inches long. The pins should be rated to last up to a year and a half in field use. An acceptable product is North American Green Bionet SC150BN, or approved equal.

2.2.10 Hydro Mulch (for slopes steeper than 3H:1V)

Flexterra Flexible Growth Media, or approved equal. Functional longevity shall exceed 18 months.

2.3 HABITAT LOG

Twelve to 20 foot long bole salvaged from on-site clearing operations with a minimum butt diameter of 6 inches. At least 50% of habitat logs shall be oak. Norway maple may also be used.

2.4 HABITAT BOULDER

Rounded or oblong granite boulder with a minimum diameter (or length)

between 2 and 3 feet.

2.5 WATER

Water sources for manual watering may be a combination of yard hydrants (if approved by the Town of Brookline and Boston Water and Sewer Commission) and watering trucks. Watering trucks shall be equipped with appropriately sized equipment to reach planted areas from adjacent park paths or other locations approved by the Contracting Officer.

2.6 HERBIVORE EXCLUSION FENCING

2.6.1 Protection of Planted Area

To protect planted areas, exclusive of wetland shelves: Rigid metal fence posts with a minimum length of six feet. Post shall be drilled to allow attachment of fencing to post using UV stabilized cable ties. Fencing shall be four (4) ft. high UV stabilized plastic, wire, or nylon coated with 0.5 to 1 inch mesh size.

2.6.2 Protection of Planted Wetland Shelves

To protect planted wetland shelves: As above, but fencing material shall be chain link and extend 6 inches (minimum) below substrate to exclude carp.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide tree protection, top soil, soil testing, tree, shrub, vine, groundcover, plug, rhizome, and bulb planting, fertilizer, mulch, habitat logs, habitat boulders, herbivore exclusion, and maintenance during the plant establishment period. Seeding, including seeding in areas designated as "seed", is specified in Section 32 92 19 SEEDING. Invasive species control is specified in Section 32 94 00 INVASIVE PLANT CONTROL.

3.2 PREPARATION

3.2.1 Plant Selection

At least 15 days prior to the expected planting date the Contractor shall request in writing that the Contracting Officer authorize the Landscape Architect to select and tag material to be planted under this Section. The Contractor shall arrange and pay for transportation and overnight accommodations, if necessary, for the Landscape Architect during the period of time required for selection and tagging of plant material.

All plants for the project shall be individually tagged with the Landscape architects' seal and no plants shall be accepted for delivery to the site without such seal.

Plants shall be selected by the Landscape Architect at the place of growth for conformity to specification requirements as to quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work. Cost of replacements shall be borne by the Contractor.

3.2.2 Tree Protection

Existing trees to remain within the work area, as shown on the contract drawings or as directed by the Contracting Officer, shall not be damaged. Protective measures, including but not limited to, perimeter fencing and trunk protection shall be installed as shown in project drawings and as directed by the Arborist and Contracting Officer. Site access roads shall be planned to avoid and minimize soil compaction near the trees and no soil compaction shall be permitted within drip lines. Proposed access roads shall be approved by Contracting Officer.

3.2.3 Soil

3.2.3.1 Topsoil

Install topsoil as shown on the contract drawings. Topsoil shall be compacted as specified in Section 31 00 00 EARTHWORK. Topsoil shall meet composition specifications per Subpart "Composition" of this section. One soil test for physical properties and organic matter content shall be submitted for each 300 CY of topsoil installed. One soil test for contaminants shall be submitted for each 2,000 CY of topsoil installed. Test results for a batch of topsoil shall be provided to the Contracting Officer at least 5 days prior to installation.

3.2.3.2 Testing of Existing Soil

Six soil samples shall be collected from representative locations that will not be backfilled with new topsoil during restoration activities. These samples shall be tested for pH, cation exchange capacity, salinity, plant nutrients, and organic matter. The testing laboratory shall provide recommendations for application of lime and/or a fertilizer to support growth of grasses, trees, and shrubs specified for the restoration area. Soil sample locations shall be approved in advance of sampling by the Contracting Officer.

3.2.3.3 Topsoil for Plant Pits

Maintain one or more stockpiles of approved topsoil to be substituted for material excavated from holes if soil testing required in Subpart "Testing of Existing Soil" indicated the excavated material is not acceptable for use as backfill.

Maintain one or more stockpiles of leaf compost to be mixed with material excavated from the from plant hole if soil testing required in Subpart "Topsoil" indicates the excavated material is acceptable for use as backfill if mixed with the compost.

3.2.4 Turf Reinforcement Mat (TRM)

The topsoil banks shall be lined at the waterline on both sides of the river with a coir log and coir turf reinforcement mat (TRM). The specific stations of the TRM are provided on the contract drawings. The TRM shall be installed to extend two feet into the water along the slope of the bank and extend eight feet above the normal water level. The TRM shall be pinned or stapled in position. Overlaps should be set with the upstream section of TRM set above the downstream TRM. The overlaps and pins shall be installed in accordance with manufacturer's instructions. Follow manufacturer's recommendations for installation.

3.2.5 Silt Fence

Install silt fence as shown on the contract drawings as specified in Section 01 57 23 STORMWATER POLLUTION PREVENTION MEASURES.

3.2.6 Herbivore Exclusion Fence

Install fencing to protect areas to be planted with emergent plants (plugs, rhizomes, and bulbs) as shown on the contract drawings.

3.2.7 Habitat Logs

Salvage and stockpile or obtain from off-site thirty (30) habitat logs during on-site clearing as directed by the habitat restoration specialist.

Install habitat logs at locations specified in contract drawings prior to planting. Avoid compacting soil during installation. Habitat logs shall be anchored to the ground. Anchoring system shall be Duckbill Anchoring System, Model 40-DB1 and arbor tie straps, or approved equal.

3.2.8 Underground Utilities

Verify and mark location of any underground utilities in restoration areas. Notify the Contracting Officer if underground utilities are encountered. Any relocation of plant material because of underground utilities shall be directed by the Landscape Architect and approved by the Contracting Officer.

3.3 PLANTING

3.3.1 Schedule

The Contractor shall time the delivery of materials for planting to minimize on-site storage time prior to installation. Plant material shall generally not be stored on-site longer than one (1) week.

3.3.2 Seasons for Planting

Trees, Shrubs, Vines, and Ferns: May - June 15; September 15 - October 15

Plugs: May 1 - June 15

Seeding (native wildflowers and grasses): April 1 - June 15; September 15 - November 15

Seeding (winter rye - temporary cover): September 1 to October 15

3.3.3 Layout

Stake out plant material locations as shown on Contract Drawings for Approval by the Landscape Architect before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet field conditions.

3.3.4 Planting (trees, shrubs, vines, and ferns)

3.3.4.1 Plant Pits

In areas protected with turf reinforcement mat, cut slit in mat sufficient

to allow for planting operations. Minimize size of cut as much as possible.

Plant pits shall be excavated with sloped sides with dimensions shown in the contract drawings. Holes shall be at least six inches larger in diameter than the root ball container and 6" deeper.

The Contracting Officer shall be notified immediately if underground obstructions, debris, or utilities are encountered at a restoration site.

3.3.4.2 Handling and Setting

Plant root and earth balls must be damp and protected from exposure to sun and wind.

Move plant materials only by supporting the root ball or container. Set plants on hand compacted layer of prepared backfill soil mixture. Set plant materials, in relation to surrounding finish grade, depth at which they were grown in the nursery or container. Reject plant material whose root balls are cracked or damaged either before or during the planting process. Remove tree wrap and reject any trees with damaged trunks.

For balled and burlapped stock backfill to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

Remove the container from container grown stock prior to setting. Gently loosen roots as needed and reject any material that is excessively root bound.

3.3.4.3 Backfill

Use soil test results to determine if material excavated from plant pits is suitable for reuse as backfill. Excavated material which does not meet topsoil composition requirements for physical parameters shall be replaced with new topsoil. Excavated material which meets physical parameters but is low in carbon content may be augmented with leaf compost (1:1) mix.

Construct earth mounded watering basin for individual plant pits as shown in Contract Drawings for trees and shrubs. Do not construct watering basins for ferns.

Remove excess soil from the work site.

3.3.4.4 Fertilizer

Apply slow release granular fertilizer as a top coat following the manufacturer's recommendations.

3.3.4.5 Turf Reinforcement Mat

Reinstall turf reinforcement mat after fertilizer is applied. Use additional matting as needed to completely cover the plant pit and earth mounded watering basin.

3.3.4.6 Bark Mulch

Provide mulch topdressing over plant pit, including earth mounded watering basin around plants to a depth of 3 inches after completion of plant installation, fertilizer application, and first watering. Keep mulch out of the crowns of shrubs. Place no mulch within 2 to 3 inches of base of shrubs and ferns or within 12" of tree trunk. No mulch is required in areas protected with turf reinforcement mat.

3.3.4.7 Watering

All plant material shall be watered twice within the first twenty-four hours of the time of planting. At each watering the soils around each plant shall be thoroughly saturated.

3.3.4.8 Pruning

Each tree and shrub shall be inspected by the Arborist and pruned as necessary to remove dead wood and all broken or badly bruised branches.

3.3.5 Planting Plugs

Install at density specified in the contract drawings. Stager rows as shown in the contract drawings. In areas protected with erosion control blanket, cut slit in blanket sufficient to allow for planting operations. Minimize size of cut as much as possible. Top growth may be trimmed prior to planting as recommended by the restoration specialist.

The root ball of plugs shall be watered prior to planting to reduce floatation. Root balls shall be gently loosened prior to planting. Plugs shall be set plumb and held in position until sufficient soil has been firmly placed around the plug. Plugs without healthy aboveground growth shall be rejected. Plan planting so as to avoid walking within previously planted areas.

Material shall be watered twice within the first 48 hours after planting unless soil in planting area is saturated.

3.4 Hydromulch and Seeding

After planting is complete hydromulch and seed slopes including areas protected with turf reinforcement mat. Apply hydromulch according to manufacturers specifications and recommended application rate for site conditions. Take care not to coat stems, trunks, or leaves of trees, shrubs, and other plantings with hydromulch. Wash hydromulch off leaves which are inadvertently coated. Hydromulch and seed shall be applied after planting unless earlier application of hydromulch to control erosion is approved by the Contracting Officer. If planting is accomplished after application of hydromulch, spot treatment will be required to stabilize any areas left bare of hydromulch during planting. Retreatment shall occur within five days of planting. Wetland Seed Mix shall be broadcast by hand seeding. Seeding shall be in accordance with Section 32 92 19 SEEDING.

3.5 Clean Up

Excess and waste material shall be removed from the installed area and disposed off-site. If the nursery accepts plant containers for reuse, the containers shall be returned to the nursery.

3.6 GUARANTEE FOR TREES, SHRUBS, VINES AND FERNS

3.6.1 Guarantee Period

Following installation of all plant material, the Contractor and Contracting Officer shall inspect the planting work. If plant materials and workmanship are acceptable to the Contracting Officer, written notice will be given by the Contracting Officer to the Contractor stating that the work has received provisional acceptance and that the Guarantee Period shall commence. The Guarantee Period shall extend until October 15 in the second calendar year following the year in which provisional acceptance was granted. The minimum duration of the Guarantee period shall be 24 months.

Activities during the Guarantee Period:

- a. Plants that show obvious decline or loss of twenty (20) percent of healthy growth shall be inspected by a licensed Arborist or Horticulturist to determine the cause of the decline. The plant shall then be treated and if further decline or loss occurs the plant shall be removed and replaced. All replacements shall be plants of the same species, variety, and size specified in the PLANT SCHEDULE unless variation are authorized in writing by the Contracting Officer.
- b. Costs of replacements shall be borne by the Contractor, except when such replacement is required due to vandalism, activities by other government agencies, and storm damage. Costs of replacements required due to herbivore damage (e.g. rabbit, vole, deer, geese), shall be borne by the Contractor.
- c. Plants shall be inspected each spring and fall following provisional acceptance of the plant material. A [Condition Report](#) shall be provided after each inspection which details the condition of the plants and recommendations for any corrective action.

3.6.1.1 Performance Standards

At the end of the Guarantee Period, the Contractor shall again inspect the plant material and any plant required under this contract that is dead or unsatisfactory shall be removed from the site. Each plant shall show at least 80 percent healthy growth and shall have the natural character of a plant of its species in accordance with the American Nurserymen's Association Standards. Dead or unsatisfactory plants shall be replaced during the normal planting season. The Contracting Officer shall make a final inspection for acceptance after the replacement plants have been maintained in satisfactory condition for one year.

3.7 GUARANTEE FOR EMERGENT VEGETATION

3.7.1 Guarantee Period

Following completion of all plant material installation, the Contractor and Contracting Officer shall inspect the planting work. If plant materials and workmanship are acceptable, written notice will be given by the Contracting Officer to the Contractor stating that the work has received provisional acceptance and that the Guarantee Period shall commence. The Guarantee Period shall extend until September 15 in the second calendar year following the year in which provisional acceptance was granted. The minimum duration of the Guarantee period shall be 24 months.

Costs of replacements shall be borne by the Contractor, except when such replacement is required due to vandalism, activities by other government agencies, and storm damage. Costs of replacements required due to herbivore damage (e.g. muskrat, geese, and carp), shall be borne by the Contractor.

3.7.2 Performance Standards

At the end of the two (2) year Guarantee Period emergent vegetation shall meet the following performance standards:

Wet Meadow Vegetation (shoreline fringe, typically elevation 1.3 to 2.3 in Back Bay Fens): Greater than 75 percent cover (with no gaps without vegetation greater than 10 feet long). Cover shall be assessed along entire length of restored shoreline in sequential increments not to exceed 300 feet in length.

Emergent Vegetation (shelf areas): Greater than 75 percent cover in planted areas (excluding cattail). Cover to be assessed separately in each shelf area.

3.7.3 Inspection

Areas planted with emergent wetland plants shall be inspected by the and Landscape Architect and Contracting Officer each April and September during the Guarantee Period. After the inspection a written report shall be submitted to the Contracting Officer which shall include the following information: percent cover estimates for all planted shoreline and emergent shelf areas, and recommendations for corrective action. Selective replanting will be required if percent cover in any area fails to meet performance standards at the end of the Guarantee Period. The Contracting Officer may also require selective replanting if percent cover in any area is less than 50 percent at the end of the first growing season. All replacements shall be plants of the same species, variety, and size specified in the PLANT SCHEDULE unless variation are authorized in writing by the Contracting Officer.

3.8 YEARLY MONITORING AND MAINTENANCE SUMMARY REPORT

The Contractor shall submit a yearly report which documents all monitoring and maintenance activities from October to September. The report shall encompass all aspects of site restoration and maintenance, including all planted and seeded areas, and invasive species control. Draft reports shall be submitted to Contracting Officer for review and approval no later than November 15. Reports shall assess compliance with performance standards, describe maintenance activities, and recommend corrective actions as required. The reports shall satisfy permit monitoring and reporting requirements. The approved work plan shall include an outline of the yearly monitoring and maintenance summary report.

3.9 MAINTENANCE

Maintenance shall begin immediately after each plant is planted and continue until the final acceptance of the restored area by the Contracting Officer.

Maintenance shall consist of keeping plants in a healthy growing condition and shall include watering, pruning, remulching, erosion control, fertilization, tightening and repairing of anchors and guys, maintaining

herbivore exclusion fencing, removal of dead plant material, removal of weeds, and resetting trees and shrubs to upright positions. Seasonal spraying for insects or disease and spraying for weed control shall also be included as recommended by the Arborist and approved by the Contracting Officer. Maintenance of lawn areas is specified in Section 32 92 19 SEEDING

During the maintenance period, any decline in the condition of plantings shall require the Contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturalists to inspect plant materials and to identify problems and recommend corrective procedures.

3.9.1 Watering

The Contractor shall water all trees, shrubs, and perennials as required to maintain healthy plant growth. Plants shall be inspected for watering needs at least twice each week during the initial growing season. At each watering the soil around each plant shall be thoroughly saturated.

Water sources for manual watering may be a combination of hydrants (if approved by Boston Water and Sewer Commission) and/or watering trucks.

Materials and methods for watering shall be those which encourage slow and deep water infiltration and water conservation. Existing trees and planted material shall not be damaged by watering equipment. Soil shall not be compacted or eroded by watering or watering equipment.

3.9.2 Fertilization

None required during plant establishment period for areas planted with trees and shrubs. Lawn areas may require fertilization as specified in Section 32 92 19 SEEDING.

3.9.3 Pruning

All planted trees and shrubs shall be inspected in the spring and fall by the Contractor and Contracting Officer.

Dead or broken branches and branches which interfere with proper development of trees and shrubs shall be identified and removed as directed by the Arborist in the field.

All pruning must be in compliance with ANSI Z133 and ANSI A300. All pruning cuts shall be made according to ANSI A300, Section 5.2.5. Wood dressing shall not be applied. Severed branches shall be removed from the site by the end of the workday. Upon completion of the pruning, the Arborist and the Contracting officer shall inspect the site again. The Contracting Officer will issue written approval of the pruning once the work is satisfactorily completed.

3.9.4 Resetting of Plants

Any trees or shrubs that are not in an upright condition shall be reset as directed by the Arborist.

3.9.5 Pest Control

Spraying for both insect pests and diseases shall be included during the maintenance period as required and as directed by the Arborist and approved by the Contracting Officer.

3.9.6 Herbivore Control

The Contractor shall install protectors on individual shrub plantings or take other measures to deter stem damage (i.e. girdling) by herbivores. Means and methods to prevent herbivore damage shall be approved by the Contracting Officer prior to installation. The Contracting Office may require Contractor to remove protection at the end of the Guarantee period.

3.9.7 Mulch

All individual trees and shrub beds not protected by erosion control matting shall be remulched yearly in April to maintain a minimum mulch depth of three inches deep.

3.9.8 Erosion Control

Areas protected with Turf Reinforcement Matting and hydromulch shall be free of erosion during the Guarantee period. TRM and mulch shall be repaired or refreshed as necessary to prevent erosion. Eroded areas shall be restored to grades as shown on the contract drawings.

3.9.9 Herbivory and Herbivore Exclusion Fencing

Inspect emergent plantings biweekly for damage by herbivores (including but not limited to waterfowl, muskrat, and carp) and report any damage to the Contracting Officer. Inspect herbivore exclusion fencing biweekly during growing season (March 15 - October 15) and repair as needed to maintain functionality. Remove at end of the two year warranty period with prior approval from the Contracting Officer. Fencing shall be maintained over winter.

3.9.10 Weeding

As required, but not limited to, non-invasive herbaceous weeds such as mugwort, burdock, common mullen, pokeberry, and other species as directed by the Contracting Officer. This is exclusive of invasive plant species control as specified in Section 32 94 00 INVASIVE PLANT CONTROL. Lawn areas may require weed control as specified in Section 32 92 19 SEEDING.

3.9.11 Invasive Plant Species Control

Maintenance activities shall be coordinated with invasive plant species control specified in Section 32 94 00 INVASIVE PLANT CONTROL.

3.9.12 Litter and Leaf Pick-up

Leaf and litter pick up during the Guarantee Period is the responsibility of the Contractor. Litter pick up shall occur biweekly from mid March through mid November. Leaf pick-up shall occur biweekly from 1 September through mid-December, in advance of mowing.

3.10 Final Inspection

A final inspection shall be held by the Contracting Officer in consultation with the Non-Federal Sponsors, to determine that all deficiencies have been satisfactorily corrected.

3.11 Extension

Following completion of the Guarantee Period, the and Landscape Architect and the Contracting Officer shall inspect the site. If the plant material and workmanship are acceptable, written notice will be given by the Contracting Officer. If remedial action is required to meet performance standards, the Contracting Officer will extend the Guarantee Period until performance standards are met. Maintenance during the extended Guarantee period shall continue and will be the responsibility of the Contractor.

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SECTION 32 94 00

INVASIVE PLANT CONTROL

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SECTION 32 94 00

INVASIVE PLANT CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section includes but is not limited to the requirements for invasive plant control and removal and applies to all work areas. Section 32 93 00 PLANTING specifies planting and other aspects of habitat restoration. Work at all areas shall include post restoration invasive species control measures for two growing seasons following site restoration. Invasive plant control methods shall include cutting and treatment of cut stumps with herbicide and foliar application of herbicide using hand held equipment or a wipe technique. Primary invasive species of concern in the work area include Norway Maple (*Acer platanoides*), Tree of Heaven (*Ailanthus altissima*), Buckthorn (*Frangula alnus*), Oriental Bittersweet (*Celastrus orbiculatus*), Japanese Knotweed (*Polygonum cuspidatum*), Common Reed (*Phragmites australis*), and Purple Loosestrife (*Lythrum salicaria*). Control of other plant species classified as "invasive" by the ENNPSI-MA will also be required as directed by the Contracting Officer, and shall be in accordance with ISCP-BMP.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

MASSACHUSETTS INVASIVE PLANT ADVISORY GROUP

ENNPSI-MA (2005) The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts

THE NATURE CONSERVANCY

ISCP-BMP Invasive Species, Control Methods, and Best Management Practices
(<http://tncweeds.ucdavis.edu/control.html>)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

1.3 QUALIFICATIONS

1.3.1 Invasive Species Control Supervisor

Invasive species control shall be supervised by an individual with at least 3 years experience directing invasive species control activities at wetland or upland habitat restoration sites in the northeastern United States. The individual shall have, at a minimum, a B.S. or B.A. degree in biology, agriculture or a related field, be proficient at identification of invasive plant species likely to occur in the work area, and possess a current Massachusetts pesticide applicators license.

1.3.2 Invasive Species Control Specialist

Invasive species control specialists shall have at least 2 years experience controlling invasive species at wetland or upland habitat restoration sites in the northeastern United States. The specialist shall be able to recognize invasive plant species likely to occur in the work area and possess a current Massachusetts pesticide applicators license.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Invasive Species Control Supervisor; G, DO

The Contractor shall submit a resume summarizing the professional qualifications, including education and invasive species control experience, of the proposed control specialist. A brief description of invasive species control projects supervised by the person during the last three years shall be provided as an attachment. The project description shall include the project name, location, size, and for at least two projects, the name, phone number, and email address of a client reference.

Invasive Species Control Work Plan; G, DO

The Contractor shall submit a work plan describing proposed invasive plant species control measures. The work plan shall include the following information and be consistent with the specifications and the Order of Conditions issued by the Boston and Brookline Conservation Commissions.

- a. A plan showing the location of all areas where invasive species control is required.
- b. List of species to be controlled and a description of each target species sufficient to allow field identification. The description shall include diagnostic photos and/or line drawings.
- c. Proposed methods for controlling each target species. This shall include the herbicide trade name, EPA registration number, concentration applied, and method of application. This information shall be summarized in a table.
- d. Description of systematic search method.
- e. Methods for marking, cutting, and removing invasive vegetation in the Upper Fens Pond work area.
- f. Schedule for the marking, cutting, and removal of vegetation from the Upper Fens Pond Work area and for herbicide application in all five work areas.
- g. Measures to minimize herbicide affects on non-target

vegetation.

h. Pesticide use restrictions related to weather conditions (wind, rain).

i. MSDS sheets and product labels for all pesticides and surfactants.

j. Waste disposal plan for pesticide containers, unused mixed product, and plant material removed from the Upper Fens Pond work area.

k. Location and description of on-site area used for on-site storage of hazardous materials, including pesticides, surfactants, dyes, and marking paint and mixing of pesticides.

l. Spill control plan.

m. List of required equipment and supplies.

n. Plan for record keeping, including a pesticide use data reporting sheet.

o. Quality control and quality assurance plan.

p. Name and company affiliation of the Invasive Species Control Supervisor and specialists who will apply herbicides.

q. Copy of current Massachusetts pesticide applicator license for all personnel who will supervise or apply herbicides.

r. Contact information for the Invasive Species Control Supervisor, including land-line and wireless phone numbers and an email address.

s. A copy of the Order of Conditions issued by the Boston and Brookline Conservation Commissions for Phase 2 of the Muddy River project.

1.5 SHIPMENT, DELIVERY, INSPECTION, TESTING, STORAGE, AND HANDLING OF MATERIALS

1.5.1 Delivery of Materials

Pesticides, surfactants, and marker dyes shall be delivered to the site in the original containers bearing legible product labels indicating the EPA registration numbers and the manufacturer's registered uses.

1.5.2 Storage of Materials

Pesticides and surfactants may be stored on site at a secure location provided by the Contracting Officer. If materials are stored on site, the Contractor shall provide a storage cabinet that meets all applicable state and federal hazardous materials storage regulations, including 29 CFR 1910, Section 106 (d)(3)(i&ii); "Design, Construction, and Capacity of Safety Storage Cabinets". Materials shall be stored in their original containers.

1.5.3 Record Keeping

Federal and State laws require record keeping for all applications of pesticides on public lands. The Contractor shall provide complete, accurate, and detailed records throughout the duration of the contract. The Contractor shall keep records of all pesticide applications and provide the Contracting Officer with legible, readable copies of such.

Reports shall be provided to the Contracting Officer within one week of completion of each round of control activities. Information provided shall include a map showing area treated (20 scale plan), list of species treated, names of pesticide and surfactant used, concentration of herbicide applied, volume of product and product mix used, method of application, and man hours expended on-site for control activities.

Daily weather records showing: high and low temperatures during the daily applications, highest wind speed during daily applications, wind direction during daily applications and precipitation within 24 hours of the daily applications. Weather information may be obtained from the Logan Airport office of the National Weather Service or an on-site weather station.

PART 2 PRODUCTS (NOT USED)

See Subpart "Species Specific Guidelines".

2.1 Herbicides and Surfactants

The following herbicides may be used: Triclopyamine and Glyphosate. Commercial formulations that may be used include: Ortho Brush-B-Gon, Garlon 3A, Garlon 4, RODEO, AQUAMASTER, and ACCORD, or approved equal. Surfactants shall be non-ionic and approved for use near water.

A copy of the product label for all herbicides and surfactants being used shall be available on-site.

PART 3 EXECUTION

3.1 GENERAL

The work areas include all areas disturbed by construction activities and restored by planting and/or seeding. Section 32 93 00 PLANTING specifies planting and other aspects of habitat restoration at these areas. Invasive plant control methods shall include cutting and treatment of cut stumps with herbicide and foliar application of herbicide using hand held equipment.

3.1.1 Targeted Invasive Plant Species

Primary invasive species of concern in the work area include but are not limited to Norway Maple (*Acer platanoides*), Tree of Heaven (*Ailanthus altissima*), Buckthorn (*Frangula alnus*), Oriental Bittersweet (*Celastrus orbiculatus*), Bush Honeysuckle (*Lonicera maackii*), Japanese knotweed (*Polygonum cuspidatum*), Common Reed (*Phragmites australis*), and Purple Loosestrife (*Lythrum salicaria*). Control of other plant species classified as "invasive" by ENNPSI-MA will be required as directed by the Contracting Officer, and shall be in accordance with ISCP-BMP. Cattail (*Typha* spp.) shall not be considered an invasive species.

3.1.2 Preliminary Site Inspection

Before the start of control measures, the Invasive Species Control Supervisor and Contracting Officer shall inspect each restoration area to assess the level of infestation of targeted invasive plant species and review the search method.

3.1.3 Applicator Training and Orientation

The Contractor shall conduct an on-site training session one to two weeks prior to start of invasive plant control. The purpose of the training session is to familiarize pesticide applicators with site conditions, the identification of targeted invasive species, and search methods. The date, time, and location of the training session shall be provided to the Contracting Officer five days in advance of the session.

3.1.4 Work Plan

A copy of the work plan shall be available on-site during invasive plant control operations.

3.2 Control Measures

3.2.1 Timing and Duration of Control Measures

Control measures shall be employed at all work areas and may include, but are not limited to, pulling and bagging and application of herbicides. At each area, control measures are required for two growing seasons following completion of planting and seeding. If planting and seeding in an area is completed by June 15, control measures are required until September 15 of the following year. During each growing season a minimum of two rounds of invasive species control are required. Approximate control periods shall be July 1 - July 15 and September 1 - September 15.

3.2.2 Search Method

The Contractor shall systematically search the entirety of each restoration area for seedlings, saplings, or mature plants of targeted species. Control specialists shall be familiar with juvenile and mature growth forms of the targeted species.

3.2.3 Herbicide Mixing, Loading, and Cleaning of Equipment

Mixing, loading, and equipment cleaning shall be done in a designated area approved by the Contracting Officer. The designated area shall be 200 feet from surface waters and not accessible to the general public. No wastewater from the equipment cleaning area shall reach surface waters, catch basins, or dry-wells.

3.2.4 Application Methods

The following herbicide application methods are acceptable: foliar application using hand held spray equipment, foliar application using a wipe (cloth or glove) technique, cut stem or cut stump treatment, and injection. All herbicide use shall be in accordance with label instructions, State and Federal law, and the Order of Conditions received from the Boston and Brookline Conservation Commissions. Herbicides shall be applied by Massachusetts certified pesticide applicators.

Foliar application using hand held spray equipment or the wipe technique shall wet the leaves of the target plant sufficiently to provide an effective dose of the herbicide. This technique shall be used primarily on herbaceous plants, seedling of invasive trees and shrubs, and root suckers (tree of heaven).

Stem "cut and treat" herbicide applications involve the cutting and removal of the growing plant stems and then the spot application of herbicide to the freshly cut surface of the remaining rooted portion of the stem. This technique shall be applied mostly to trees and shrubs with a basal diameter greater than ca. ¼ inches. The "spot" application shall be accomplished with a swab and shall occur immediately after the stem is cut. A marking dye shall be used to identify which stems have been treated. Trees and shrubs shall be cut using loping shears or a handsaw. Trees larger than two inches in diameter may be cut with a chain saw.

3.2.5 Species Specific Guidelines

The Table below provides recommendations for control of invasive plant species likely to occur in the Muddy River project area. Control measures for other species shall be developed by the Contractor as necessary and approved by the Contracting Officer. In all cases, herbicides shall be used according to the EPA approved product label.

<u>Species</u>	<u>Life Form</u>	<u>Suggested Active Ingredient</u> ⁽¹⁾⁽²⁾	<u>Suggested Application Method</u> ⁽³⁾
Norway Maple	Tree/sapling	Tricopyr or glyphosate	Cut stump
	Stump sprout	Tricopyr or glyphosate	Foliar
	Seedling	Tricopyr or glyphosate	Foliar
Tree of Heaven	Tree/sapling	Tricopyr	Cut stump
	Stump sprout/sucker	Tricopyr or glyphosate	Foliar
	Seedling	Tricopyr or glyphosate	Foliar
Buckthorn and Honeysuckle	Mature plant/sapling	Tricopyr or glyphosate	Cut stump
	Stump sprout/sucker	Tricopyr or glyphosate	Foliar
	Seedling	Tricopyr or glyphosate	Foliar
Bittersweet	Mature plant	Tricopyr or glyphosate	Cut stump
	Stump sprout/sucker	Tricopyr or glyphosate	Foliar
	Seedling	Tricopyr or glyphosate	Foliar
Knotweed	Mature plant	Tricopyr	Foliar
	Mature plant	Glyphosate	Injection or cut stump
	Basal regrowth/seedling	Tricopyr	Foliar
Phragmites	Mature Plant	Glyphosate	Foliar
	Basal regrowth/seedling	Glyphosate	Foliar
Purple Loosestrife	Mature plant	Glyphosate	Foliar
	Basal regrowth/seedling	Glyphosate	Foliar

⁽¹⁾Active Ingredient

<u>Species</u>	<u>Life Form</u>	<u>Ingredient</u> ⁽¹⁾⁽²⁾	<u>Method</u> ⁽³⁾
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⁽²⁾Foliar application of Tricopyr is not permitted for vegetation growing along the shoreline.

⁽³⁾Foliar: hand held spray equipment or wipe.

3.2.6 Limits on Operations

The pesticide application may occur before other site construction, including prior to the construction fence installation, and after receipt of the Notice to Proceed. Foliar herbicide application operations shall be suspended when any one of the following conditions exist in a treatment area: 1) wind velocity exceeds ten (10) miles per hour; 2) heavy dew is present on leaf surfaces; 3) precipitation is expected to be received in quantities sufficient to wash chemicals off plants within 6 hours of application; 4) non compliance with local, state, or federal regulations or the Product Label; and 5) as directed by the Contracting Officer. Cut stump treatment shall be suspended if precipitation is expected to be received within six hours of application.

3.2.7 Avoidance of Impacts to Non-target Species

The Contractor shall be careful to avoid damage to adjacent non-target herbaceous and woody vegetation with herbicides. Any non-target tree or shrub damaged during invasive species control operations shall be replaced in kind at the Contractor's expense. Damaged is defined as less than 80% healthy growth as per Section 32 93 00 EXTERIOR PLANTING AND HABITAT RESTORATION.

3.2.8 Area Specific Requirements and Site Conditions

a. All Areas.

Control of seedlings of targeted invasive species in areas disturbed by construction activities. The preferred control method will be hand pulling and/or herbicide application using the wipe method or highly focused foliar application using a small hand held sprayer. Invasive species control may begin prior to erection of construction fencing.

b. Work Areas 2-4, 6, and 11-12.

Invasive species control in this areas will largely involve eradication of Japanese knotweed and residual (unexcavated) Phragmites or Phragmites seedlings. The recommended method for knotweed will be cutting once during the growing season followed by herbicide application in September. Planting trees and shrubs in areas overgrown with knotweed shall not occur until after control efforts have been underway for at least one growing season. After planting, herbicide shall be applied using the wipe method or highly focused foliar application using a small hand held sprayer.

c. Work Areas 5, and 7-10.

Invasive species control in this areas will largely involve eradication of residual (unexcavated) Phragmites or Phragmites seedlings. The recommended method will be two herbicide applications in late summer and fall, separated by at least two weeks. For isolated, low density patches, herbicide shall be applied using the wipe method or highly focused foliar application using a small hand held sprayer.

3.3 DISPOSAL

3.3.1 Disposal of Plant Material

The Contractor shall dispose waste material generated off site in accordance with applicable local, state, and federal disposal regulations. The Contracting Officer may request that boles larger than 6" in diameter be salvaged for on-site use as habitat logs.

3.3.2 Herbicide Containers

Herbicide containers shall be disposed of by the Contractor in accordance with all local, State, and Federal requirements.

3.4 SAFETY

The Contractor and all application personnel shall review, understand, and follow the herbicide container label recommendations, requirements, precautions, and prohibitions.

Pesticide applicators shall wear appropriate personal protective equipment, including long sleeved shirts, neoprene gloves, and other measures recommended on the product label. Although not required on the product label, gloves shall be worn during application of herbicides containing glyphosate.

The public shall be excluded from all restoration areas by fencing during application of herbicide. Herbicides shall be applied so that pesticide drift does not reach adjacent gardens, turf areas, or walkways.

3.5 PUBLIC NOTIFICATION

Signage shall be installed to alert the public of herbicide applications required in local, State, and Federal pesticide control laws and regulations.

3.6 PERFORMANCE STANDARDS AND MONITORING

3.6.1 General

3.6.1.1 Phragmites

At the completion of control efforts no Phragmites shall be present within any of the work areas.

3.6.1.2 Other Invasive Species

At the completion of control efforts, percent cover of invasive plant species other than phragmites shall cumulatively be shall be less than 2% in each work area.

3.6.2 Inspection

The Contracting Officer and Contractor shall inspect the site on or about October 15 of each year to assess compliance with the performance standards.

3.6.3 Notification of Deficiencies

The Contractor will be notified of any deficiencies in writing.

3.6.4 Corrective Action

The Contractor shall submit a Corrective Action Plan to address deficiencies noted during the inspections.

3.6.5 Final Inspection

A final inspection will be held by the Contracting Officer to determine that all deficiencies have been satisfactorily corrected.

-- End of Section --

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SECTION 33 01 00

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SECTION 33 01 00

GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 GENERAL

1.1 SUMMARY

The work of this section includes developing a geotechnical instrumentation plan; furnishing, installing, and maintaining geotechnical instrumentation; protecting instrumentation from damage; and reading, reducing and reporting of data. Specific items to be addressed include vibration monitoring, deformation monitoring of sheet pile systems, and ground water well monitoring. The Contractor shall implement required remedial and precautionary measures based on the instrumentation data.

The vibration monitoring shall be implemented at all times when driving or removing sheet piles. Monitoring shall occur between the sheet piles and the nearest building or structure. Of particular concern are the Agassiz Road Bridge, the Fire Department Building, the Avenue Louis Pasteur Bridge, and the Richardson Bridge (Boylston Street).

Deformation monitoring shall be implemented for all sheet pile systems in order to measure any deformation over time.

Ground water wells shall be monitored to determine if any lowering of the groundwater table adversely affects the wooden foundations of existing buildings. Existing monitor wells can be located by referring to the website bostongroundwatermap.org. Note that there are no wells in the vicinity of Areas 1 through 6 and therefore no groundwater monitoring is required for work in these areas.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

GERMAN INSTITUTE FOR STANDARDS

DIN 18723 (1990) Field Procedure for Precision
Testing of Surveying Instruments

1.3 PURPOSE OF GEOTECHNICAL INSTRUMENTATION PROGRAM

A. Purposes of the Geotechnical Instrumentation Program include but are not limited to providing:

1. Pre construction baseline data for comparison with construction and post construction data.
2. Monitoring of ground, groundwater, and facilities during and after construction, to determine whether they have been adversely affected by construction activities.
3. A forewarning of unforeseen conditions that may require remedial or

precautionary measures.

B. The Government is not responsible for the safety of the work based on geotechnical instrumentation data.

1.4 RESPONSIBILITIES OF CONTRACTOR

A. Develop an adequate instrumentation plan.

B. Furnish components of instrumentation that are to be installed during construction.

C. Install instruments.

D. Protect from damage and maintain instruments installed by the Contractor, and existing instruments installed by others. Repair or replace damaged or inoperative instruments.

E. Install, monitor, report and interpret data from new and existing instrumentation.

F. Implement plans of action.

1.5 QUALIFICATIONS OF CONTRACTOR'S INSTRUMENTATION PERSONNEL

A. The Contractor's instrumentation personnel shall include a qualified Geotechnical Engineer who has at least five years of experience in developing instrumentation plans, installation and monitoring of the types of instruments discussed herein and in interpreting instrumentation data. This engineer shall:

1. Prepare detailed instrumentation plan including step by step procedures and bar chart as specified in Subpart SUBMITTALS, for all instruments specified herein.

2. Be on-site and supervise at least the first two installations of each type of instrument.

3. Be available for consultation at all times for the duration of the Contract.

4. Supervise interpretations of geotechnical instrumentation data.

B. The person in responsible charge of the surveyors shall be a Registered Land Surveyor in the Commonwealth of Massachusetts with a minimum of three years of experience in deformation measurements of the types and accuracies referenced herein. The field survey party chief shall have a minimum of one year of experience in deformation survey measurements of the types and accuracies referenced herein.

1.6 QUALITY ASSURANCE

A. A factory calibration shall be conducted on all instruments prior to shipment. Certification shall be provided to indicate that the test equipment used for this purpose is calibrated and maintained in accordance with the test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to the National Institute of Standards and Technology.

B. A final quality assurance inspection shall be made prior to shipment. During the inspection, a checklist shall be completed to indicate each inspection and test detail. A completed copy of the checklist shall be supplied with each instrument.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Resumes of the Geotechnical Engineer

Within 3 weeks after the Notice to Proceed, submit to the Contracting Officer for information only resumes of the Geotechnical Engineer and of the Land Surveyor, sufficient to define details of relevant site experience.

Instrumentation Plan

Submit within four weeks of receipt of the Notice to Proceed.

Procedure for Installation

At least 45 Days prior to commencing installation of the first of each type of instrument, submit to the Contracting Officer for information only the following items pertaining to that instrument type:

1. Detailed step by step procedure for installation, together with a sample installation record sheet. The procedures shall be bound and indexed. The installation procedures shall include as a minimum:
 - a. Method for protecting instruments from damage.
 - b. Detailed step by step procedures for conducting all optical survey measurements to the specified accuracies shall include types of surveying instruments, all as specified herein, and data reduction procedures. The manufacturer's stated accuracy and the field procedures shall be such that the resulting accuracies meet the specified accuracies at a 95 percent level of confidence.
 - c. Detailed plan of vibration monitoring, including the location of seismographs, to ensure the limits of gravel vibration indicated in this section are not exceeded at abutter buildings and structures.
2. A bar chart indicating the proposed time sequence of instrument installation.

SD-03 Product Data

Specified Instruments

Within five Workdays of the Notice to Proceed, submit manufacturers' product data describing all specified instruments to the Contracting Officer for information only, including equivalent or better substitutions, if any, together with product data and instruction manuals for requested substitutions.

Factory Calibration

Quality Assurance Checklist

Warranty for each Portable Readout Unit

Within two Workdays of receipt of each instrument at the site, submit to the Contracting Officer a copy of factory calibration, completed copy of quality assurance checklist, and warranty for each portable readout unit.

Installation Record Sheet

Within five Days of installing each instrument, submit to the Contracting Officer the installation record sheet for that instrument, including as-built instrument location as specified.

As-built Instrument Location Plans

Every four weeks submit to the Contracting Officer updated as-built instrument location plans as specified in Subpart GENERAL INSTALLATION.

SD-07 Certificates

Manufacturer's Test Equipment Certification; G, RO

Within 2 Workdays of receipt of each instrument at the site, submit to the Contracting Officer a copy of manufacturer's test equipment certification.

1.8 SCHEDULING WORK

Install instruments, document and submit formal initial readings in accordance with Article DATA COLLECTION and the following schedule:

1. Deformation monitoring points shall be installed and formal initial readings documented at least 30 Days prior to any excavation within 200 feet of the instrument or any dewatering activity.

Variations in the schedule shall be subject to the Contracting Officer's acceptance.

1.9 STORAGE OF INSTRUMENTS

All instrumentation materials, after receipt at the site and prior to installation, shall be stored in an indoor, clean, dry, and secure storage space. Instruments shall not be exposed to temperatures outside the manufacturer's stated working temperature range.

PART 2 PRODUCTS

2.1 MATERIALS

A. All materials shall be new.

B. Whenever any product is specified by brand name and model number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the product desired. The term "acceptable equivalent" shall be understood to indicate that the "acceptable equivalent" product is the same or better than the product named in the specifications in function, performance, reliability, quality, and general configuration. This procedure is not to be construed as eliminating from competition other suitable products of equal quality by other manufacturers.

C. Any consideration of a substitution shall clearly state the nature of the deviation from the product specified.

D. The Contractor shall provide readout units as needed for making preinstallation and post installation acceptance tests, and for taking any required readings during installation, as well as the subsequent readings.

E. The Contractor shall furnish all installation tools, materials, and miscellaneous instrumentation components.

F. Surface protection shall be flush with the ground surface in paved or other areas. For all instruments surface protection shall consist of a model 26T 6855 LF Top Only roadway box with a plain 5 1/4 inch lock lid as manufactured by Tyler Pipe, Tyler, TX, or a model 0624 roadway box with matching lock lid cover, as manufactured by Bresnahan Foundry, Worcester, MA, or acceptable equivalent.

G. All graduations shall be in U.S. Customary Units, for example, feet, inches, pounds.

2.2 SURVEYING INSTRUMENTS FOR VERTICAL DEFORMATION MONITORING

Instruments used for vertical deformation monitoring shall have a minimum accuracy of ± 1.5 mm (standard deviation for one kilometer of double run leveling) and a minimum setting accuracy of ± 1.0 arc seconds. Leveling staffs shall be non telescopic in design (i.e., 'Chicago' style leveling staff). A bull's eye bubble shall be used to plumb the leveling rod.

2.3 SURVEYING INSTRUMENTS FOR HORIZONTAL DEFORMATION MONITORING

A. Instruments used for horizontal deformation monitoring shall have a minimum accuracy of ± 3.0 arc seconds (standard deviation according to [DIN 18723](#)) and a minimum display reading less than or equal to the accuracy. Distances less than 30 feet shall be measured with a standardized steel tape used in conjunction with a tension handle. Distances greater than 30 feet shall be measured with an Electro Optical Distance Measuring Instrument (EDM). Distances between 30 and 100 feet shall be verified with a standardized steel tape in conjunction with a tension handle. Electronic pointing shall be used to minimize error due to possible misalignment of the EDM axis and telescope. Centering shall be accomplished using high precision optical plummets or mechanical centering devices.

- B. EDM equipment used for horizontal deformation monitoring shall, after calibration, have a minimum accuracy ± 5 mm plus 5 parts per million.

2.4 DEFORMATION MONITORING POINTS

Deformation monitoring points (DMPs) shall be used to monitor vertical and horizontal deformation of the excavation support systems. A DMP shall consist of an observable point punchmarked on the top horizontal surface of steel sheeting, soldier pile, or other steel surface. The steel surface within 3 inches of the point shall be cleaned by wire brush to permit easy identification of the exact point. The point shall also be clearly identified using fluorescent spray paint adjacent to the point.

2.5 SEISMOGRAPHS

Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities. Provide model DS 477 Blastmate III as manufactured by Instantel Inc., Kanata (Ottawa), Ontario, Canada, or acceptable equivalent. The seismograph shall have the following minimum features:

1. Seismic range: 0.01 to 4 inches per second with an accuracy of ± 5 percent of the measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inches per second or less.
2. Acoustic range: 110 to 140 dB (referenced to 20 micro Pascals) with an accuracy and resolution of ± 1 dB.
3. Frequency response (± 3 dB points): 2 to 200 Hertz.
4. Three channels for vibration monitoring plus a fourth channel for overpressure.
5. Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.
6. Capable of internal dynamic calibration.
7. Direct writing to printer and capability to transfer data from memory to removable storage drive. Instruments must be capable of producing strip chart recordings of readings on site within one hour of obtaining the readings. Provide computer software to perform zero crossing frequency analyses of waveform data on magnetic disks.
8. Self triggering wave form capture mode that provides the following information: plot of wave forms, peak particle velocities, peak overpressure, frequencies of peaks.
9. Continuous monitoring mode must be capable of recording single component peak particle velocities.

2.6 FACTORY CALIBRATION

- A. A factory calibration shall be conducted on instruments at the place of manufacture prior to shipment. Each instrument shall be marked with a unique identification number. Quality assurance procedures during factory calibration shall be as specified in Subpart QUALITY ASSURANCE.

B. Factory calibration of seismograph vibration monitors shall be performed using a shake table and a reference sensor traceable to the National Institute of Standards and Technology. Factory calibrations of overpressure sensors shall be performed using a calibrator traceable to the National Institute of Standards and Technology.

PART 3 EXECUTION

3.1 PRE INSTALLATION TESTS

A. When instruments are received at the site, the Contractor's instrumentation personnel shall perform pre installation acceptance tests to ensure that the instruments and readout units are functioning correctly prior to installation. Pre installation acceptance tests shall include relevant items from the following list as a minimum:

1. Examine factory calibration curve and tabulated data, to verify completeness.
2. Examine manufacturer's final quality assurance inspection check list, to verify completeness.
3. Check cable length.
4. Check tag numbers on instrument and cable.
5. Check, by comparing with procurement document, that model, dimensions, and materials are correct.
6. Verify that all components fit together in the correct configuration.
7. Check all components for signs of damage in transit.

B. During pre installation acceptance testing of each instrument the Contractor's instrumentation personnel shall complete a pre installation acceptance test record form.

C. An instrument that fails the specified pre installation acceptance test shall be repaired such that it passes a subsequent pre installation acceptance test, or shall be replaced by an identical instrument at no additional cost to the Government.

3.2 GENERAL INSTALLATION

A. The Contractor's instrumentation personnel shall install instruments in accordance with the Contractor's detailed step-by-step procedures that were submitted as specified in Subpart SUBMITTALS.

B. The Contractor shall notify the Contracting Officer at least 24 hours prior to installing each instrument.

C. The Contractor shall extend installed instrumentation and reinstall roadway boxes as necessary as grade changes occur, and revise instrument reference elevations as necessary.

D. As each instrument is installed, an installation record sheet shall be prepared, including appropriate items from the following list as a minimum:

1. Project name.
 2. Contract name and number.
 3. Instrument type and number, including readout unit.
 4. Planned location in horizontal position and elevation.
 5. Planned lengths and volumes of backfill.
 6. Personnel responsible for installation.
 7. Plant and equipment used.
 8. Date and time of start and completion.
 9. Spaces on record sheet for necessary measurements or readings required at hold points during installation to ensure that all previous steps have been followed correctly, including instrument readings made during installation.
 10. As built location in horizontal position and elevation including:
 - a. Elevation referenced to the Project Elevation Datum (NAVD 1988), together with the location of the point used for the elevation measurement.
 - b. Horizontal position referenced both to Massachusetts State Plane Grid Coordinates and to project Baseline Station and Offset, together with the location of the point used for horizontal position measurement.
 - c. Taped horizontal distances to the instrument, measured to an accuracy of ± 1 foot from permanent physical features in the field. A sufficient number of taped measurements shall be included on the sketch to establish a unique horizontal position for the instrument. If such features are removed, the Contractor shall provide a new sketch, prior to removal, with taped measurements to other features.
 11. As built lengths and volumes of backfill.
 12. Result of post installation acceptance test.
 13. Weather conditions at the time of installation.
 14. A space on record sheet for notes, including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.
- E. An instrument that fails the specified post installation acceptance test shall be replaced by an identical instrument.
- F. After installation, roadway boxes shall be free draining. Roadway boxes that are not free draining shall be repaired or replaced.
- G. The Contractor shall submit updated as-built instrument location plans to the Contracting Officer. The location plans shall as a minimum be

reproducible composite plans of all installed instruments plotted on 11 inch x 17 inch or 24 inch x 36 inch sheets at a scale of 1 inch = 100 feet. The first plans shall be submitted within two weeks after completion of the first instrument installation. Updated plans shall be submitted every subsequent 2 weeks. Updated plans need not be submitted for periods during which no instruments have been installed.

3.3 INSTALLATION OF DEFORMATION MONITORING POINTS (DMPs)

A. Deformation monitoring points (DMPs) shall be installed on elements of the earth support system. As a minimum, DMPs shall be installed at 50 foot horizontal intervals along the support system.

B. After installation of a DMP, determine as built location in horizontal position to an accuracy of ± 0.03 foot and elevation to an accuracy of ± 0.05 foot.

3.4 INSTALLATION OF SEISMOGRAPHS

Vibration sensors shall be installed at locations to be decided by the Contractor to provide adequate documentation that specified threshold and limiting values are not exceeded at abutting buildings and structures, as detailed in the Contractor's submitted plan. As a minimum, at least two locations shall be monitored for each vibration producing activity. Seismograph vibration sensors shall be firmly mounted on the surface slab of concrete or asphalt, or firmly set and weighted down in undisturbed soil.

3.5 FIELD CALIBRATION AND MAINTENANCE

A. The Contractor's instrumentation personnel shall conduct regular maintenance of field terminals and accessible instrument components. Maintenance shall include both instruments installed by the Contractor and existing instruments installed by others, namely the observation wells installed by the Boston Groundwater Trust.

B. Seismographs shall be calibrated by the manufacturer, as specified in Subpart FACTORY CALIBRATION. Subsequently such calibrations shall also be performed at least once a year. A current certificate of calibration shall be submitted to the Contracting Officer for information only.

C. When using survey instruments, the Contractor shall perform an EDM calibration to determine the zero error and scale error on a calibration baseline which meets National Geodetic Survey's (NGS) standards (ex. Georgetown, Marlboro, etc.). The length of the calibration baseline shall span a range of distances that will be encountered during the Work. Prior to performing the calibration, the Contractor shall check the adjustment of the tribachs. The calibration shall be performed every 6 months, and the results applied to each distance measurement. The Contractor's level shall be peg tested, and adjusted if necessary once a week to check for collimation error.

3.6 DATA COLLECTION

A. Formal initial readings in observation wells shall be taken in the Contracting Officer's presence.

B. Collected data shall be recorded on field data books or electronic dataloggers, and shall include as a minimum the following:

- project name
- contract name and number
- instrument type
- date and time
- observer
- readout unit number
- instrument number
- readings
- remarks
- visual observations
- other causal data including weather, temperature, and construction activities.

Contractor's data shall be recorded in U.S. Customary Units, such as feet, inches, pounds.

C. A formal initial observation well reading shall consist of the average of three readings with the water level indicator. The indicator will be removed from the riser pipe between these three readings. Each reading other than the formal initial reading shall be a single reading with the water level indicator. Reading accuracy shall be ± 0.05 foot.

D. The following shall apply to the DMPs:

1. For vertical deformation monitoring, runs shall be performed by a single run beginning and ending on two different permanent benchmarks. Deformation monitoring points shall be used as turning points or as intermediate foresights from two different turning points, allowing elevations to be adjusted and eliminating significant observational errors. The maximum length of line of sight shall be 230 feet, and the imbalance between backsight and foresight shall not exceed 30 feet. Allowable level loop misclosure shall not exceed ± 0.033 times the square root of M feet (where M is the distance of the level run in miles) for a single run between two deep benchmarks. A formal initial reading on a deformation monitoring point will consist of the average of three elevations, from three independent level runs which meet the closure specified herein. Elevations established subsequent to a formal initial reading shall be determined as specified herein.

2. For horizontal deformation monitoring, if a theodolite is used, the direction measurements shall be made in two sets of direct and reverse pointings, changing the circle setting by 90 degrees between sets. Reduced directions shall be rejected if they deviate from the mean by more than 5 arc seconds. The theodolite shall be plumbed over the occupied point by a high precision optical plummet or mechanical centering device. When distances are measured with a tape, each distance shall be measured independently two separate times and shall be corrected for the temperature and tension of the tape. A formal initial reading on a deformation monitoring point will consist of the average of three readings, from three independent set ups, each as specified herein. Each reading other than the formal initial reading shall consist of a single set of readings, as specified herein. All readings shall be referenced to stable horizontal control points. Reading accuracy shall be ± 0.03 foot. Horizontal control points will be installed by others.

E. Vibration data shall be collected prior to any vibration producing construction activities to document background vibrations. A minimum of 24 continuous hours during a weekday shall be monitored at every location

shown on the Contractor supplied plan. The same and other locations as appropriate shall also be monitored at the start of vibration producing construction activities near each location, to establish the maximum energy which can be used without surpassing specified vibration and overpressure levels at abutting buildings and structures within 500 feet of the activity locations. A minimum of two locations shall be monitored for each vibration inducing activity. Thereafter, vibrations shall be monitored during construction at the location closest to the construction activity, and at additional locations deemed appropriate by the Contractor. The Contractor shall have access to additional seismographs to be deployed as necessary to respond to abutter complaints. Monitoring at all submitted locations shall be performed during all vibration producing activities to include, but not be limited to, sheet pile driving and concrete structures and pavement excavation and demolition. Monitoring during these activities shall consist of recording single component peak particle velocities, which shall be printed on a strip chart or recorded electronically. Continuous monitoring and full waveform data shall be recorded and submitted as specified herein. During all monitoring of vibration producing construction activities the Contractor shall document all events that are responsible for the measured vibration levels, and submit the documentation to the Contracting Officer with the data for information only.

3.7 DATA REDUCTION, PROCESSING, PLOTTING, AND REPORTING

A. The Contractor shall provide data to the Contracting Officer in accordance with the following schedules:

1. Data on existing observation wells shall be collected once per week for the duration of the contract. Data on DMPs shall be collected on a weekly basis, as long as the excavation support elements are in place. Data in seismographs shall be collected continuously during vibration producing activities.

2. All data except survey data shall be provided no later than 4:00 p.m. on the day following the day on which data are collected.

3. Survey data will be provided no later than 24 hours after the time period specified in Subpart DATA REDUCTION, PROCESSING, PLOTTING, AND REPORTING, A.1.

4. When the periods specified in Subparts DATA REDUCTION, PROCESSING, PLOTTING, AND REPORTING, A.2 and A.3, are interrupted by weekends or holidays, the periods will be increased by up to 24 hours for each weekend day or each holiday day.

B. Each week the Contractor shall submit to the Contracting Officer a description of the work performed during that week including:

1. A description of groundwater control and temporary pressure relief operations. This description shall include the pump locations (plan location and depth), times and duration of operation, and estimated quantity of flow from dewatering operations as well as metered quantity of flow from each well.

2. A summary of the support system construction activities. This summary shall include a location plan and narrative indicating any pile driving activities, excavating and concreting for caissons (or other similar foundation supports), installation and pre stressing of struts, and tieback drilling, grouting, and stressing.

3. A summary of excavation and filling activities. This summary shall include a location plan and a description of where excavation has occurred during the week, together with plots of the elevation of the bottom of the excavation or top of the fill versus station, showing a plot for the current date and one each for the three previous weeks.

4. A description and location of any construction activities other than excavation support system, excavation and filling, including any surcharge caused by temporary construction loads.

5. A report of any unusual events that may have affected the instrumentation readings. This report shall include a description of any remedial or precautionary measures that were implemented during the week in response to geotechnical instrumentation or other data, including when they were implemented and for what reason. The report shall also include a description of any future remedial or precautionary measures that are planned in response to existing geotechnical instrumentation or other data.

C. When data indicate that a change has occurred as specified in Subpart INTERPRETATION OF DATA AND IMPLEMENTATION OF PLANS OF ACTION, the Contractor shall initiate the response action(s) specified therein.

D. The data shall be reported as follows:

1. Raw and reduced data shall be on summary tables in printed tabular format on 8 1/2 inch x 11 inch sheets of paper.

2. Data for up to 8 like instruments that are located in the same geographical area may be plotted on the same plot. Each plot shall be submitted on an 8 1/2 inch x 11 inch sheet.

3. In addition to hard copy data as specified herein, the Contractor shall provide data on a portable memory storage device.

E. Plots of observation well data shall show groundwater table elevation versus time. The elevation of the lowest available pre-construction elevation (historic low) shall be shown on the plot.

F. Plots of deformation data at deformation monitoring points (DMPs) shall show absolute vertical deformation versus time and absolute horizontal deformation versus time.

G. Plots of vibration data shall be the following types: strip charts and full waveform plots.

1. For seismograph data collected in continuous monitoring (strip chart) mode the Contractor shall provide a permanent record of single component peak particle velocity. The strip chart shall also indicate the time and magnitude of maximum single component peak particle velocity measured during each one hour interval of the monitoring period.

2. For seismograph full waveform data, the Contractor shall provide plots consisting of a graphical display of the three component particle velocities and overpressure levels during the entire course of the vibration producing construction activity.

H. If the Contractor collects data from an instrument that has been installed to replace a damaged instrument, the formal initial reading for the damaged instrument shall be used as an initial reading for the replacement instrument so that data are plotted continuously, without an offset at the time of damage. The time of damage and replacement shall be noted on the plot.

3.8 DAMAGE TO INSTRUMENTATION

A. The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations, weather, traffic, and vandalism.

B. If an instrument, including an existing instrument installed by others, is damaged or inoperative, the Contractor's instrumentation personnel shall repair or replace the damaged or inoperative instrument within 72 hours at no additional cost to the Government. The Contractor shall notify the Contracting Officer at least 24 hours prior to repairing or replacing a damaged or inoperative instrument.

3.9 DISCLOSURE OF DATA

The Contractor shall not disclose any instrumentation data to third parties and shall not publish data without prior written consent of the Contracting Officer.

3.10 INTERPRETATION OF DATA AND IMPLEMENTATION OF PLANS OF ACTION

A. The Contractor shall interpret the data, including making correlations between instrumentation data and specific construction activities. Instrumentation data shall be evaluated to determine whether the response to construction activities is reasonable.

B. Table 1 indicates Threshold and Limiting Values for selected instruments. These values shall be defined collectively as Response Values. The actions associated with these Response Values are defined below. Response Values are subject to adjustment by the Contractor's geotechnical engineer as indicated by prevailing conditions or circumstances. However, if the values are adjusted to less stringent standards than specified, then the Contracting Officer shall approve of the specification deviation before its implementation.

TABLE 1 - RESPONSE VALUES

Observation Wells Water Elevation	Frequency (Hz)	Threshold Value: 0.5 Ft below historic low*	Limiting Value: 1.0 Ft below historic low*
Seimographs - Peak Particle Velocity (inches/second)	10 - 30 30 - 60	0.2 0.2 - 0.3	0.3 0.3 - 0.5
Deformation Monitoring Points on excavation Support System	Horizontal Movement	0.5% of active excavation height	1.0% of active excavation height
	Vertical Movement	0.5% of excavation height	1.0% of excavation height

*historic low is the lowest preconstruction elevation recorded in the instrument; as determined by the Contracting Officer.

C. If a Threshold Value is reached the Contractor shall:

1. Meet with the Contracting Officer to discuss his plan of action(s).
2. Implement the plan of action applicable to reaching a Threshold Value, so that the Limiting Value is not reached.
3. Install additional instruments as required.

D. The Contractor shall take all necessary steps so that the Limiting Value is not reached. The Contractor shall suspend activities in the affected area with the exception of those actions necessary to avoid reaching the Limiting Value.

E. If a Limiting Value is reached, the Contractor shall:

1. Meet with the Contracting Officer to discuss his plan of action(s).
2. Implement the plan of action applicable to reaching a Limiting Value.

3.11 DISPOSITION OF INSTRUMENTS

A. Remove salvageable instruments as necessary.

B. Portable readout units used by the Contractor during installation, during pre and post installation acceptance testing, and for collecting Contractor's data are the property of the Contractor.

C. Upon completion of the Work, the Contractor shall remove and dispose of those portions of instruments constituting an obstruction, including observation wells. The upper two feet of the instrument shall be removed, together with the ground surface protection. The remaining open portions of the instrument and casing shall be backfilled with cement grout up to a level two feet below the ground surface, and with lean concrete in the upper two feet. New pavement patches shall be constructed, in paved areas, of the same material and to the same thickness as existing adjacent

pavement. Disturbed or damaged surfaces shall be restored to the condition existing before installation of the instrument.

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SECTION 33 11 00

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SECTION 33 11 00

DISCHARGE PIPE FOR FIRE STATION FLOOD PUMP

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C153/A21.53	(2011) Ductile-Iron Compact Fittings for Water Service
AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pipe, Fittings, Joints and Couplings; G, RO

SD-07 Certificates

Pipe, Fittings, Joints and Couplings

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store jointing materials under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, and other accessories free of dirt and debris.

1.3.2 Handling

Handle pipe, fittings, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace material found to be defective before or after laying with sound material without additional expense to the Government.

Handle ductile iron pipe, fittings, and accessories in accordance with [AWWA C600](#).

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.2 PIPE, FITTINGS, JOINTS AND COUPLINGS

Submit manufacturer's standard drawings or catalog cuts.

2.2.1 Ductile-Iron Piping

2.2.1.1 Pipe and Fittings

[AWWA C151/A21.51](#), Pressure Class 350 psi, Thickness Class 0.25 inches. Fittings, [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#); fittings with push-on joint ends are to meet the same requirements as fittings with mechanical-joint ends, except that the bell design is to be factory modified for push-on joint. Provide fittings with pressure ratings equivalent to that of the pipe. Pipe ends and fittings are to be compatible for the specified joints. Provide cement-mortar lining, [AWWA C104/A21.4](#), twice the standard thickness on pipe and fittings.

2.2.1.2 Joints and Jointing Material

Provide push-on joints or mechanical joints for pipe and fittings.

a. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly as recommended in [AWWA C111/A21.11](#).

b. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets as recommended in [AWWA C111/A21.11](#).

2.3

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE

3.1.1 General Requirements for Installation of Pipe

Submit [manufacturer's instructions](#) for pipe installations. These manufacturer's instructions apply to all pipe installation except as noted herein.

3.1.1.1 Earthwork

Perform earthwork operations in accordance with Section [31 00 00 EARTHWORK](#).

3.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate joints and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

3.1.1.3 Penetrations

Provide ductile-iron or Schedule 40 steel wall sleeves for pipe passing through walls of valve pits and structures. Fill annular space between walls and sleeves with rich cement mortar. Fill annular space between pipe and sleeves with mastic.

3.2 CLEANUP

Upon completion of the installation of pipe and appurtenances, remove all debris and surplus materials resulting from the work.

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SECTION 35 31 19

STONE PROTECTION AND GRAVEL BEDDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C97/C97M (2009) Absorption and Bulk Specific Gravity of Dimension Stone

ASTM D5519 (2007) Particle Size Analysis of Natural and Man-Made Riprap Materials

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

State Specifications (1988) Standard Specifications for Highways and Bridges; Supplemental Specifications Dated June 6, 2006; Standard Special Provisions Dated November 20, 2007

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1906 (1970) Laboratory Soils Testing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Source; G, DO

The sources from which the Contractor proposes to obtain material for the production of gravel bedding, stone bedding and stone protection materials shall be selected well in advance of the time when these materials will be required in the work.

SD-04 Samples

Samples; G, DO

Suitable samples of processed natural materials, as applicable, from sources shall be submitted to the Contracting Officer for approval of the soundness and durability of the stone, gravel

particles and sand particles. Quarried samples shall be representative of the whole quarry and include materials from distinctive strata and beds suitably identified by numbers and quarry name. Submission of the quarried samples shall designate each sample and its location within the quarry and include available geologic descriptions, records and methods of testing and history of use in similar construction. Stone samples shall consist of two or more pieces, each piece weighing a minimum of 20 pounds. All samples shall be obtained by the Contractor and delivered at his expense at a time which will allow a period of 30 days for testing and investigations. Unless otherwise directed at the time of sampling, each sample shall be delivered by the Contractor to the Government's facility at 696 Virginia Road, Concord, Massachusetts, 01742. Sampling of the materials shall be done at the source by the Contractor at his own expense and in the presence of a representative of the Contracting Officer.

SD-06 Test Reports

Testing; G, DO

The Contractor shall have testing performed on the selected stone sources for stone protection and stone bedding in accordance with ASTM C97/C97M. Sampling and testing of the materials shall be done at the source by the Contractor at his own expense and in the presence of a representative of the Contracting Officer.

1.3 DELIVERY STORAGE AND HANDLING

Stone protection materials may be stockpiled in approved areas at the project site. Gravel bedding materials shall not be stockpiled at the project site without prior approval. Such approval will be given only for small stockpiles of gravel bedding materials which must be readily available in small quantities. All stockpile areas shall be cleared, stripped, and graded as directed prior to placement of materials. The placement of materials in stockpiles and their excavation and hauling from stockpiles shall be done in a manner that will prevent segregation and/or contamination and will assure the placement of well-graded materials.

1.4 SEQUENCING AND SCHEDULING

The Contractor shall plan the sequence of construction of the work covered herein with the work covered in this and other sections of the specifications to ensure minimum damage due to all causes, including high river flows and stream erosion to partially completed portions of channel side slopes, earth structures, concrete structures, gravel bedding and stone protection, and to comply with the requirements in this and other sections of the specifications. Construction of stone protection on fill and excavation slopes shall start at the toe of the slope and progress up the slope. The Contractor shall maintain the portions of bedding layers and stone protection until accepted, and any material displaced by any cause shall be replaced at his expense.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Stone Protection Materials

2.1.1.1 General

Stone protection materials shall consist of hard, durable and sound quarried rock fragments furnished by and at the expense of the Contractor. Each stone shall have a density of not less than 162 pounds per cubic foot based upon the saturated surface dry specific gravity determined in accordance with [ASTM C97/C97M](#). The stones shall be irregular and angular in shape and shall be free from open or incipient cracks, seams, structural planes of weakness or other defects that would tend to increase unduly their deterioration from natural causes and from handling and placing. No stone in the material shall have its long dimension exceeding 3 times its short dimension. Stone protection material shall be well graded between the maximum and minimum stone sizes furnished. The maximum and minimum sizes furnished shall be selected by the Contractor and shall produce a material without "skip gradation" with stone sizes within the limits specified. The selection will depend on his processing operations, shapes of stones and other factors. All stones for the production of stone protection material shall be obtained from one general rock type in one quarry. The gradation of riprap and stone materials will be visually estimated in stockpiles and during placement. Additional gradation testing ([ASTM D5519](#), Method C) may be required by the Contracting Officer prior to placement if stockpiles have gap graded materials.

2.1.1.2 Stone Protection for Pedestrian Bridges

Stone protection materials for the pedestrian bridges shall meet the following gradation and size requirements. Stone protection shall be approximately 1 foot in rounded diameter, with the maximum limit of stone weight (pounds) for percent lighter by weight (Wx) as follows:

Percent Lighter by Weight	Maximum Limit of Stone Weight in Pounds (lbs)
W100	325
W50	165
W15	86

Range: Maximum = 325 lbs, Minimum = 35 lbs

Stone protection materials may contain up to 5 percent, by weight, of air dried rock fragments, spalls and dust with each particle weighing less than the permissible minimum stone size. No particles weighing less than the permissible stone size shall be defined as a stone in stone protection materials. In computing percentages by weight of stone in the above table, the weight of particles weighing less than the permissible minimum stone size shall not be included in the total weight.

2.1.2 Gravel Bedding

Gravel bedding material shall conform to the requirements of Section M1.03.0, Type b "Gravel Borrow" of the [State Specifications](#). Gravel bedding materials shall consist of sand, gravel or crushed stone composed of tough, durable particles and shall be reasonable free of thin, flat and

elongated pieces. The materials shall contain no organic matter or soft friable particles in quantities considered objectionable by the Contracting Officer. The materials shall be reasonably well graded within the limits specified below:

Sieve Size (U.S. Standard)	Percent Passing by Dry Weight
3-inch	100
0.5-inch	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

In addition, not more than 10 percent by dry weight of the component passing the No. 4 sieve shall pass the No. 200 sieve.

2.2 TESTING AND APPROVAL

The samples shall be subjected to such tests as are necessary to determine the quality of the material unless suitable test reports or service records are available that are satisfactory to the Contracting Officer. The Contracting Officer shall be the sole judge as to the acceptability of a material. Tests to determine the suitability of the rock and gravel materials may include, as applicable, petrographic analysis, specific gravity, abrasion, absorption, sulfate soundness, wetting and drying, and freezing and thawing. All testing of the initially proposed source of material will be made by or under supervision of the Government and at its expense. Any retesting and all testing of subsequent sources due to the initially proposed source failing to meet the requirements of the specifications will be done by the Government at the Contractor's expense. The approval of a material by the Government, based on test results, examination of the material exposed at the source and service records, shall not relieve the Contractor, in any way, of the responsibility of placing a material which meets the requirements specified herein. Approval of a sample of material for soundness and durability from a source shall not be construed as approval of all material from that source or that the material from a gravel source will have the required gradations for gravel bedding materials or that the stones of stone protection materials produced using material from that source will have satisfactory quality, shape characteristics, and sizes after processing and placement. The right is reserved to reject, at any time, any or all portions of the materials in a source or products using the materials from that source when such materials are unsuitable in the opinion of the Contracting Officer.

PART 3 EXECUTION

3.1 FOUNDATION PREPARATION

The surface areas upon which gravel bedding and stone protection materials are to be placed shall be trimmed and dressed to conform to the lines, grades and cross-sections shown on the drawings, or as modified, to within the tolerances specified herein. For surfaces produced by excavation and upon which gravel bedding material is to be placed, the tolerances from the specified lines and grades shall be plus 2 inches and minus 4 inches for dry areas and plus 2 inches and minus 12 inches for surfaces below water. Where it is necessary or desirable to fill a low surface area of the excavation or fill surface due to yielding or unstable material, the fill material shall be gravel bedding material. For areas upon which gravel

bedding is to be placed on fill see Section 31 00 00 EARTHWORK for requirements. Immediately prior to the placement of any gravel bedding or stone protection material, the surface upon which it is to be placed will be inspected and no material shall be placed thereon until the surface has been approved.

3.2 PLACEMENT AND TOLERANCES

3.2.1 General

Sections and layers of stone protection and gravel bedding shall be constructed to the lines, grades, and in the areas shown on the drawings or as modified by the Contracting Officer, within the tolerances specified herein. The Contractor shall organize his operations so as to minimize erosion of gravel bedding material during and after placement.

3.2.2 Gravel Bedding

Gravel bedding material shall be placed and spread uniformly on surface areas prepared as specified below and in Subpart FOUNDATION PREPARATION herein so as to provide a layer with the thickness shown on the drawings or as directed. Except as otherwise specified, the tolerances for the surface of a gravel bedding layer or section shall be plus and minus 2 inches from the specified grades or lines except that neither of these tolerances will be allowed over a continuous area greater than 200 square feet. The placement and spreading of the gravel bedding material by methods which will tend to segregate particle sizes will not be permitted. The elevation of a surface area of a layer of gravel bedding below water shall be checked immediately prior to the placement of the specified overlying material to determine if the surface is within the specified tolerances. Compaction of the gravel bedding material will not be required. Any damage to the surface of a layer of gravel bedding prior to or during placement of the overlying material thereon shall be repaired before proceeding with the work.

3.2.3 Stone Protection and Riprap

Stone protection materials shall be placed on surfaces of bedding material, prepared as specified in Subpart FOUNDATION PREPARATION above, in such a manner as to avoid segregation and to produce a well graded mass of stone with the minimum practical percentage of voids and with uniform appearance of the exposed surface in the stone protection layer or section. The full thickness of the layer shall be constructed in one operation and in such a manner as to avoid displacing the underlying material. The stone protection material, after placement at any point, shall conform to the gradations specified in paragraph Stone Protection (PART 2) of this section. Placement by dumping into chutes, pushing by bulldozers, or by other methods likely to cause segregation or breakdown of materials will not be permitted. Breaking of individual pieces in place either by blasting or mechanical methods will not be permitted. Unless otherwise approved, stone protection material shall not be placed against any concrete structures until the concrete has been in place for at least 14 days. Special care shall be exercised when placing such material against concrete structures to avoid damage thereto.

3.2.3.1 Finished Surfaces

The finished surfaces of stone protection shall be trimmed to the extent necessary and the stone shall be arranged by hand and with a backhoe or

similar equipment. The finished surface for stone protection shall have a uniform appearance of well graded material free of pockets of small stones and clusters of large stones. No bulldozer, shovels, cranes or similar equipment will be permitted to operate on the outer surface of any stone protection layer. The pockets of the finished stone protection surface shall be filled with stones of material similar to the stone protection, such that spaces between larger stones are not greater than 3 inches.

3.2.3.2 Tolerances

The finished surfaces of stone protection layers above the river level shall be within a tolerance of plus 6 and minus 6 inches from the specified lines except that the plus tolerance will not be allowed over a continuous area greater than 200 square feet. Below river level, the finished surfaces of all stone protection layers shall be within a tolerance of 0 to plus 12 inches from the specified lines. The tolerance of the finished stone protection surface will be 4 inches both above and below the water line over a continuous area not greater than a 100 square feet.

3.3 FIELD SAMPLING AND TESTING

The gradation of riprap and stone materials will be visually estimated in stockpiles and during placement. Additional gradation testing ([ASTM D5519](#), Method C) may be required by the Contracting Officer prior to placement.

Field sampling and gradation testing of materials, except for soundness and durability, specified in this section shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to the approval of the Contracting Officer. The applicable procedures prescribed in [EM 1110-2-1906](#), shall be used for determining the gradation characteristics of the materials. Copies of the test results shall be furnished to the Contracting Officer as soon as available.

Schedule of Sampling and Testing of Soils

Material Type	Minimum Sampling Schedule	Field Test Required
Gravel Bedding	1 per 500 CY of bedding placed	Gradation

-- End of Section --

Muddy River Flood Damage Reduction Project, Phase 2
Brookline/Boston, MA

Blueback Herring Trap and Truck Proposal

Draft Final

U.S. Army Corps of Engineers
New England District
Environmental Resources Section
696 Virginia Road
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December, 2017

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Muddy River Flood Damage Reduction Project, Phase 2

Brookline/Boston, MA

Blueback Herring Trap and Truck Proposal

Introduction

The Muddy River is a 3.5 mile long urban waterway with a 5.6 square mile drainage area situated in the greater Boston metropolitan area. The River originates at Jamaica Pond and flows in a generally northeasterly direction along the Boston-Brookline border, then turns into the Fenway neighborhood, and eventually flows into the Charles River. The upper watershed is primarily residential with some commercial areas, while the lower watershed is characterized by high-density residential, institutional and commercial development. The river also comprises part of Frederick Law Olmsted's "Emerald Necklace" park system. Due to the historic significance of the park system, the river is listed in the National Register of Historic Places.

The Boston Parks and Recreation Department, along with the Town of Brookline and Commonwealth of Massachusetts, commissioned a comprehensive basin wide plan entitled "The Emerald Necklace Environmental Improvements Master Plan, Phase 1 Muddy River Flood Control, Water Quality and Habitat Enhancement". This plan identified actions to reduce potential flood damages, improve water quality and habitat in the river, rehabilitate the historic landscape, and enhance recreational uses of adjacent parklands. Specific elements of the Master Plan included dredging the Muddy River system from Wards Pond to the Charles River basin, increasing the channel capacity and removing flow restrictions, stabilizing riverbanks, removing invasive vegetation, and rehabilitating the historic landscape.

Congress authorized the Corps of Engineers to evaluate the City of Boston's Master Plan and to determine whether these flood damage reduction and environmental restoration improvements were in the Federal interest. This required the preparation of a Decision Document. The September 2003 Final Decision Document evaluated alternative solutions to flood control and ecosystem problems. It selected and recommended a plan based on economic, environmental and public acceptability criteria. Flood control improvements to protect against a flood with a return frequency of 20 years were ultimately authorized for construction by the Secretary of the Army. Construction is being implemented in two phases.

Phase I involved removal of existing twin 72" culverts in three areas to daylight 700 ft. of the river and sediment removal from the Upper Fens Pond to allow for increased conveyance of flood flows. Construction of Phase 1 was largely completed in June of 2016.

Phase 2 includes removal of approximately 100,000 cubic yards of sediment from Leverett Pond, the Riverway, and Back Bay Fens. One hundred (100) percent design plans and specifications for Phase 2 are scheduled for completion in August of 2018. Construction of Phase 2 is expected to occur between October of 2019 and February of 2023. Most of the

sediment to be removed is in the Back Bay Fens. Phase 2 construction will occur at twelve “work areas” (one in Leverett Pond, five in the Riverway, and six in the Back Bay Fens (see Attachment A)). Current plans call for sediment to be removed by excavation. All work areas will be dewatered prior to excavation. In most work areas flow will be diverted around dewatered work areas by bypass pumps. Upstream and downstream fish passage will be prevented during bypass pump operation.

The Commonwealth of Massachusetts Division of Marine Fisheries has recommended that the Muddy River remain free flowing during the periods between April 1st to June 15th and between September 15th and November 1st, of any year. This restriction was recommended so that blueback herring (*Alosa aestivalis*) can complete their spring upstream adult spawning migration and fall downstream out-migration of juveniles.

Blueback herring are an anadromous fish species, spawning in freshwater, and then migrating to the marine environment to mature. During the spring, adult pre spawning blueback herring enter freshwater rivers and move upstream to spawn, generally in their natal habitat. The young then migrate downstream during the summer and fall to mature in the ocean, and then return to freshwater after 3 to 5 years to complete their life cycle. The post spawning adults generally move downstream shortly after spawning. Blueback herring generally migrate with Alewife, a similar species (*Alosa pseudoharengus*), and collectively the two species are referred to as river herring. However, only blueback herring have been reported in the Muddy River.

Blueback herring spawning habitat in the Muddy River is thought to be located at the southern end of Leverett Pond near the discharge of Babbling Brook. In order for the blueback herring to complete their life cycle they will need unimpeded passage through the Muddy River from its confluence with the Charles River, all the way upstream to their spawning habitat in Leverett Pond (i.e. nearly the entire reach of the project) during their spawning season (spring) and out migration season (fall). The spring work window was established to allow passage of the up-migrating pre-spawning and down-migrating post-spawning blueback herring adults, and the fall work window was established to allow passage of the down-migrating juveniles. These windows preclude bypass pumping in the river during most of the spring and early summer as well as during most of the fall, which could have a significant effect on the completion time of this project. If construction could occur during at least part of this timeframe without impacting the blueback herring, the project could be completed in less time. In addition, the costs associated with the contractor mobilization and de-mobilization could be avoided since work could continue during part of the migration season.

As currently envisioned, 3 spring migration periods and 4 fall migration periods would occur during Phase 2 construction. Careful timing of the work allows for unimpeded downstream passage of juveniles during the entire construction period. Bypass pumping of dewatered work areas would occur during the 2020 and 2022 spring migration periods. Bypass pumping would occur in the Back Bay Fens and prevent upstream migrating adults from reaching the Riverway and Leverett Pond. This Plan proposes to provide upstream and

downstream passage of adult herring in 2020 and 2021 by trapping and trucking to bypass dewatered work areas. This would allow construction to occur without the need to suspend work during the 2020 and 2021 spring migratory periods. This would shorten the Phase 2 construction period and avoid costs associated with contractor de-mobilization and mobilization to accommodate fish the passage windows.

Proposed Trap and Transport of Fish around Active Work Areas

Fish trapping and transport of up-migrating pre-spawning adults is a practiced method of maintaining and/or re-establishing river herring populations (including blueback herring) in different river systems throughout Massachusetts, as well as in other New England states where river herring runs are present (i.e. Rhode Island, Maine, New Hampshire). Generally, these states (including Massachusetts) have one or more permanently constructed trapping facilities which allow the transfer of these fish with minimal stress. A similar methodology following the same concept, using either seines or traps (fyke nets) could be implemented for the blueback herring in the Muddy River in order to transport them around the work area while still allowing the adults to spawn and return to the ocean. The up-migrating blueback herring would be allowed to enter one of the impoundments on the Muddy River downstream from the active work area and be captured at that location (which could include the most upstream limit of migration at the location of the bypass pump discharge). The captured fish would then be transferred to a stocking truck and transported upstream to spawn in their historical spawning habitat in Leverett Pond. The post spawned adults are expected to migrate out of Leverett Pond downstream shortly after spawning (<http://dnr2.maryland.gov/Fisheries/Pages/Fish-Facts.aspx?fishname=Alewife%20and%20Blueback%20Herring>). These downstream migrating adults would be captured at a location upstream from the work area, and then transferred to a stocking truck and transported to a location downstream from the work area so that they can continue their migration to the sea.

The eggs that were spawned in Leverett Pond would hatch and the larvae would be expected to remain in Leverett Pond during the summer (i.e., June 15th to September 15th) where they would grow to their outmigration size. In September, connectivity of the river would be re-established to allow the juveniles to move downstream and complete their seaward migration. The connectivity would be maintained until the end of the November 15 migration window, when work would resume in these areas until April 1. This would allow additional work to be done during the April 1st to June 15th timeframe between Leverett Pond and Work Area 12 that could not be done if complete upstream passage (i.e. no work) was to be maintained in those areas (i.e., Work Areas 2-11) during the spring. Timing of dredging work in Leverett Pond shall be outside of the spawning and migration periods.

Because this method would require the trapping and netting of the fish, there is potential for mortality associated with handling, which could impact the overall spawning success and productivity of that year class. This may not be an acceptable impact to this species, since populations have been declining and they are currently listed as a federal species

of concern <http://www.greateratlantic.fisheries.noaa.gov/protected/pcp/soc/index.html>, accessed, January, 2016). In addition, there may be difficulty in effectively timing the trapping operation to capture the up-migrating pre spawning adults as well as down migrating post spawning adults. In addition, the stress on the fish caused by handling and/or crowding in the transport truck may negatively affect spawning success having an overall negative effect on the year class.

This alternative would require traps and/or nets, one or more hatchery/tank trucks, and staff to deploy, tend and transfer the fish as well as to operate the truck to transport to the release area. There may also be logistical and technical concerns, in using the appropriate trap or net type, deployment of nets/traps in deep water and associated safety hazards, and the potential for any net or trap structure that is deployed to become fouled by debris floating down the river.

Proposed Capture Locations for Upstream Pre-Spawning Adult River Herring

Several possible capture locations for the up-migrating spawning adults on the Muddy River were investigated by Army Corps of Engineers New England District staff during a site visit on June 3, 2016. These included sections of the project near work Areas 10 and 11 (in the vicinity of the Boston Fire Department Communication Center off the Fenway), an area upstream from the footbridge in Area 9, as well as an area downstream from Area 12 located between Commonwealth Ave and Beacon Street, along Charlesgate East. Aerial (i.e. location) and ground level photographs of these areas are shown in Figures 1 through 6. Each of these areas has vehicle access that would allow equipment and staff to be delivered to the edge of the river, including a stocking truck, which would be loaded with the captured fish and driven to the release location in Leverett Pond. In addition to these possible capture locations, the fish could be captured at the most upstream limit of their migration, which would be at the bypass pump discharge (assuming that this area is accessible).



Figure 1. Proposed capture Area 1 for up-migrating blueback herring adults, Charlesgate.



Figure 2. Access road/path (from Commonwealth Ave) at proposed Charlesgate upstream collection Area 1. (Grassy area in background slopes down to the riverside on the right (looking upstream)).



Figure 3. Charlesgate Collection Area 1 looking upstream showing rip-rapped left bank that would provide access to river.



Figure 4. Proposed Upstream Capture Areas 2 and 3. Sections of Muddy River near Work Areas 11 and 12 (Capture Area 2) and Work Areas 9 and 10 (Capture Area 3).



Figure 5. View across river in Proposed Capture Area 2.



Figure 6. View across River in Proposed Capture Area 3.

Proposed Alternative Capture Methods

Two alternative methods are proposed for capture of the up-migrating fish. These include using a long haul/beach seine, or using one or more fyke nets/traps. These methods will be described in detail below.

Alternative Capture Method 1 - Beach/Haul Seine

Beach or haul seines are long rectangular nets generally ranging from 4 – 10 feet wide and from 25 to 300 or more feet long. There is a weighted/lead line that runs the entire length of the bottom of the net to keep the bottom submerged on the substrate, and a float line that runs along the top of the net to maintain buoyancy supporting it on the surface of water. Some seines incorporate a large bag in the center, where collected fish can be concentrated. The areas of the net on either side of the bag are called the wings. When deployed, the weighted bottom and floating top of the seine form a barrier across the water column (from surface to bottom) that will prevent the movement of fish in either direction. The wing ends usually have a length of rope that extends from the lead line and float lines, which can be attached to a wooden or fiberglass pole that allows the seine to be towed for deployment and retrieval. The seine is deployed so that it can surround a school of fish, or fish habitat, and then be towed into shore (while maintaining the lead line on the bottom and the float line on the top). A beach or haul seine can be deployed in shallow water (4 feet or less) by two or more people, where one person anchors one wing end on the shore (by holding the pole upright) and one or two people (depending on the length of the seine) wade into the water towing the other wing end (maintaining it upright in the water column) to a predetermined distance to surround the fish or habitat, and then returning to shore planting the second wing end near or adjacent to the first. The seine can then be carefully drawn in to shore with the collected fish by pulling in the lead line and float line (generally the lead line is pulled in advance of the float line in order to close the bottom of the seine) while maintaining the lead line on the bottom. The bag end with the collected fish is then emptied (by netting) and the fish transferred to their designated location. In some seines, there is no bag, however as the net is drawn into shore the fish will become concentrated in the center of the net.

In water that is too deep to wade, a small boat can be used to deploy the seine. One wing end is planted on shore, and the rest of the net is loaded onto the bow of the boat. The boat is then slowly backed out into the water (preferably by rowing) so that the net can be dispensed off the bow of the boat (with the lead line sinking to the bottom and the float line remaining on the surface) and towed/extended by the boat to its full length surrounding the fish and returning the second wing end to shore. The net is then drawn in the same way as described above when deployed by wading. Seines have been used to collect river herring for population studies (Loesch and Lund, 1977; Atlantic States Marine Fisheries Commission, May, 2012; U.S. Fish and Wildlife Service, 2014) as well as for commercial harvesting of river herring (New York Dept. of Environmental Conservation <http://www.dec.ny.gov/animals/76525.html> accessed 13 June, 2016; Atlantic States Marine Fisheries Commission, May, 2012). A photo of a seine being deployed by two people wading is shown in Figure 7.



Figure 7. Beach seine being deployed in wadeable water.

Alternative Capture Method 2 - Fyke Net

Fyke nets or hoop nets are cylindrical or conical nets constructed by weaving a length of netting around a series of concentric rings spaced out along the length of the netting, forming a cylinder/cone. One end is open to form the entrance to the net, and the other end is closed (with a drawstring) to form a chamber for captured fish (cod end). There are generally between 4 and 8 rings in the net, and at two or more of the rings, an additional internal funnel net is placed to create a series of chambers into which fish moving from the entrance of the net can be funneled (See Figure 2). The largest ring is placed at the front of the net to frame the opening which is the diameter of that ring, and the length of netting extends to the next smaller ring in the series until the last ring (in some fyke nets the opening may be rectangular, rather than circular). Fish enter through the front of the net, and as they proceed toward the back, enter each of the internal funnels, which directs them into the next chamber, until the last chamber where they are trapped (i.e. the cod end). The fish are prevented from moving back to the opening by the smaller diameter of the funnel net, which they have difficulty locating, so they collect in the cod end.

Fyke nets are generally placed in rivers with the entrance facing downstream so that fish moving upstream can be trapped by the net (although they can also be placed with the opening facing upstream to capture fish moving downstream). A series of wings (constructed of netting) can be extended at angles along each side of the entrance in order to direct fish toward the opening of the net. With long enough wings, an entire stream or river can be blocked off so

that any upstream or downstream moving fish (depending upon which direction the net is set) will be intercepted and directed into the net and be trapped. Nets can be deployed in shallower water (i.e. four feet or less) by using stakes and wading into the stream, and in deeper water by using a small boat with anchors and lines and/or in combination with stakes. This type of net is considered a passive method of capture, since it can collect fish continuously over a designated time period without having to be actively fished. At the end of a designated fishing/deployment period, the nets can be checked for captured fish which can be collected by netting from the cod end and transferring to a bucket, live well, or waiting hatchery truck.

Fyke nets have been deployed by the USFWS for the collection of up-migrating adult alewives in the Wreck Pond Inlet to the Wreck Pond River in New Jersey (New Jersey Office Field Notes, May, 2015), as well as in Alewife Brook in Cape Elizabeth Maine for the collection/monitoring of adult up-migrating alewives from Casco Bay (Alewife Brook Herring Monitoring, 2015 Pilot). It is assumed that the same methodology would collect blueback herring. An illustration of a fyke net is shown in Figure 8.

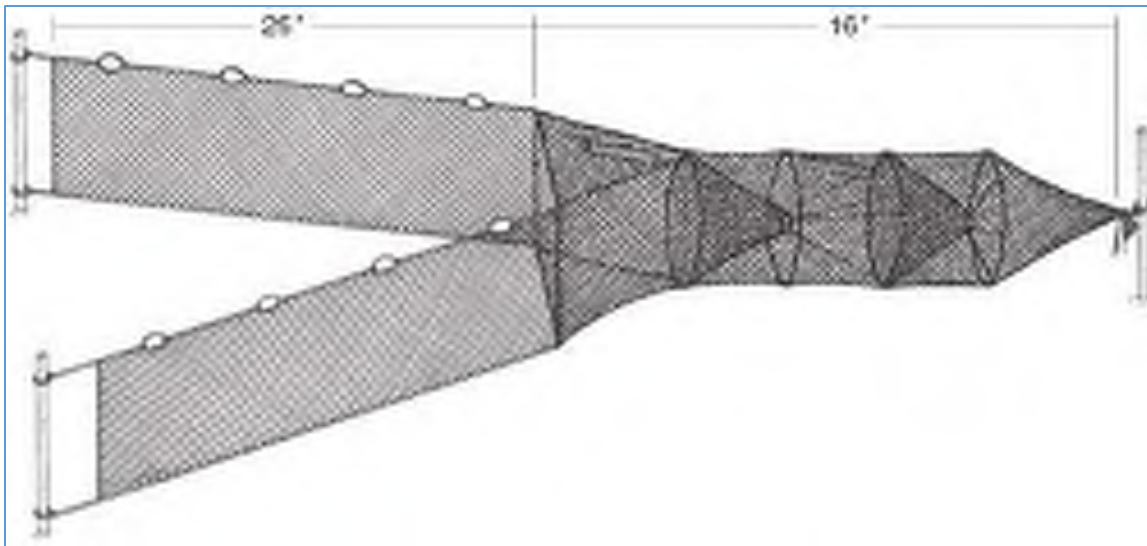


Figure 8. Fyke net showing wings that can be extended to form a barrier across the river to direct fish into the net.

Proposed Method for Capture of Pre Spawning Adult Blueback Herring in the Muddy River Using Beach Seine (Preferred Alternative)

1. A preliminary barrier net would be placed at the selected location for blue back herring capture, with a trash rack placed upstream from that net. The mesh size of the barrier net would be as large as possible, while still preventing the adult herring from moving beyond it (most likely a 3/4 inch mesh size). If there is a potential for the larger mesh net to act as a gill net for smaller resident fish that are attempting to move upstream or downstream, then a smaller mesh net could be used, however, it would need to be

tended more frequently in order to prevent fouling. If a larger mesh net is used, it would need to be checked approximately every two to three hours during the time of the spawning migration in order ensure that upmigrating blueback herring are not being caught and/or gillnetted by the nets and injured. Nets should be constructed of woven fibers or material other than monofilament in order to minimize the potential for injury that could result if the fish were to be inadvertently gillnetted by the net. Prior to setting any nets, the proposed capture area would be cleared of large debris that could potentially snag the bottoms of the nets or traps and prevent them from contacting the bottom of the river allowing fish to escape as well as preventing the net's retrieval (i.e. when using a seine). Alternatively, the fish could be collected at the location of the first barrier to upstream migration, downstream from the bypass pump discharge (if accessible). This may eliminate the need to set-up a barrier net, since the area near the discharge could be seined (assuming that it can be done safely).

2. During the spring up-migration, the adult herring would be prevented from moving beyond the barrier net and would gather in the area of the river immediately downstream from the net while attempting to move upstream (or below the discharge if the first barrier to upstream migration is used as the collection area).
3. An approximately 100 to 300 foot haul seine would then be deployed, starting from the shore approximately 50 to 100 feet downstream from the barrier seine and moving out to the opposite shore, and then moving along that shore (parallel to it) upstream to the barrier net, and then back toward the starting shore along the net in order to encircle/contain the fish. The seine would be closed by moving back toward the starting point (shore) along the barrier net. Since the depth of the river at the proposed capture locations is over four feet, a small flat bottomed row boat would need to be used to deploy the seines (including the barrier seine). A bagless seine would be used in order to minimize injury to the fish that could occur from being concentrated in the bag end when being hauled to shore.
4. Once the ends of the seine (i.e. the wing ends) are brought to shore, the net would be drawn in to concentrate the fish. In order to minimize stress to the fish, the net would remain submerged, with the fish being concentrated close to the shore to facilitate netting. Any non-target species captured in the seine would be released either upstream or downstream from the collection area.
5. Using rubberized nets, the fish would be collected from the concentrated seine, and transferred to a waiting hatchery truck. Salinity of the water in the truck would be increased to approximately (10 ppt) by using instant ocean or equivalent in (U.S. Fish and Wildlife Service, 2014) order to reduce stress on the transported fish as well as treat any scale abrasions and/or lacerations that may have resulted from the netting.
6. Depending on the amount of fish captured during each seine and the capacity and transfer density in the truck, the procedure would be repeated until all of the visible fish

in the capture area have been collected and/or maximum hatchery tank density has been reached (i.e. recommended as approximately one fish per gallon of water in the tank). In the event that the target density is not achieved within several seine hauls, the fish that have been collected in the hatchery tank will be transferred to the release site as noted below (in order to minimize the stress to the fish associated with being confined to the hatchery tank). It should be noted that the hatchery truck used should be equipped with circular holding tanks (for blueback herring), not square or rectangular.

7. The filled truck would then transport the fish to Leverett Pond, where it would be emptied (preferably by using the discharge pipe on the truck), or by netting the fish using a rubberized net, until all of the fish have been transferred. The number of fish transported and released alive would be counted and recorded along with any fish which died during transport.
8. The procedure would be repeated each day during the spawning season.

Proposed Method for Capture of Adult Upstream Migrating Blueback Herring in the Muddy River Using Fyke Net (Alternative 2)

1. A debris rack would be installed upstream at the selected collection location. Prior to setting any nets, the proposed capture area would be cleared of large debris that could potentially snag the bottom of the nets or traps preventing them from contacting the bottom of the river allowing fish to escape as well as preventing the net's retrieval (i.e. when using a seine). As noted previously in Alternative 1, the selected collection location could also be the upstream limit of migration, just downstream from the discharge of the bypass pump.
2. Just downstream from the debris trap, one or more fyke nets and/or hoop nets would be installed, with the wings extending to both sides of the river, and the trap oriented with its entrance facing downstream. Since the water in all of the proposed capture locations exceeds 5 feet, a boat will be needed to set both the fyke net and the wings. The wings would be wide enough to extend from the bottom of the river to the surface in order to effectively block fish from moving beyond them upstream. Alternatively, the fyke net could be set closer to shore in shallower water, with the wings still spanning the river, with one longer wing (stretching from the net to the opposite shore), and one shorter wing (from the net to the closer shore). However, if the net was set this way, it would not be in the thalweg, although the wings would be expected to direct all up-migrating fish into the fyke net. The approximate size of the net would depend upon the depths of the collection area, however it would be assumed that the opening would be at least three or four feet in diameter (or depth, if a square or rectangular opening is used).

3. Each day, or several times a day during the up migrating season, the holding bag of the fyke net would be examined for the presence of adult blueback herring. This could be done either by wading (if the net was set in shallower water) or by using a small boat, and rowing out to the end of the net. It should be noted that blueback herring tend to migrate in large numbers at the same approximate time. Therefore it is possible that the net could reach capacity very quickly requiring extremely frequent checking when this happens.
4. The bag would be emptied into a floating live car, or holding tank on the boat, and the adults would be transferred to a waiting hatchery truck. This would be repeated until the truck has been filled, and/or there are no additional captured fish. Net transfer would utilize rubberized nets in order to minimize scale abrasion/injury to the fish.
5. Alternatively, in the event that not all of the captured fish are collected, but are still in some of the chambers, the net could be pulled from the front, and then lifted so that all of the fish end up in the cod end. This could be done by boat, by pulling the net onto the boat from the entrance end while allowing the cod end to remain submerged.
6. The entire net, or just the cod end (some nets have removable cod ends) would then be brought to shore and emptied/transferred to a waiting hatchery truck, and then the fish would be transported to their release location in Leverett Pond.
9. The truck would release the fish by opening the discharge pipe, or by using a rubberized net to move the fish to their spawning area. The number of fish transported and released alive would be counted and recorded along with any fish which died during transport.

Proposed Capture Location of Post Spawned Downstream Migrating Adult Blueback Herring

A proposed capture area for downstream migrating blueback herring is located near Work Area 6. A flow control structure upstream of Park Drive constricts flow at this location to a narrow, easily accessible channel. An aerial photo (location map) is shown in Figure 9, and photos of the river in that location are shown in photos 10 and 11.



Figure 9. Proposed location of blueback herring post spawned adult downstream migrant collection area (Work Area 6).



Figure 10. Downstream view of river in location of proposed post spawning adult blueback herring collection area.



Figure 11. Upstream View of river in location of proposed post spawning adult collection Area.

Method for Collecting Post Spawning Adults – Beach Seine (Preferred Alternative)

1. A preliminary barrier net would be placed slightly downstream at the selected location for adult blueback herring capture (in order prevent downstream migrants from moving further downstream) with a trash rack placed upstream (approximately 100 feet) from that net. The mesh size of the barrier net would be as large as possible, while still preventing the adult herring from moving beyond it (most likely a 3/4 inch mesh size). If there is a potential for the larger mesh net to act as a gill net for smaller resident fish that are attempting to move upstream or downstream, then a smaller mesh net could be used, however, it would need to be tended more frequently in order to prevent fouling. Nets should not be constructed of mono-filament, but rather have a woven and/or coated mesh to minimize the potential for injury if the fish become trapped by their gills. Prior to setting any nets, the proposed capture area would be cleared of large debris that could potentially snag the bottoms of the nets or traps preventing them from contacting the bottom of the river allowing fish to escape, as well as preventing the net's retrieval (i.e. when using a seine).

2. During the post spawning down-migration, the adult herring would be prevented from moving beyond the barrier net and would gather in the area of the river immediately upstream from the net while attempting to move downstream.
3. An approximately 100 foot (or less) haul seine would then be deployed, starting from the shore approximately 50 to 100 feet upstream from the barrier seine and moving out to the opposite shore, and then moving along that shore (parallel to it) downstream to the barrier net, and then back toward the starting shore along the net in order to encircle/contain the fish. The seine would be closed by moving back toward the starting point (shore) along the barrier net. If the depth of the river at the proposed capture locations is over four feet, a small flat bottomed row boat would need to be used to deploy the seines (including the barrier seine). A bagless seine would be used in order to minimize the potential for injury that could occur from being concentrated in the bag.
4. Once the ends of the seine (i.e. the wing ends) are brought to shore, the net would be drawn in to concentrate the fish. In order to minimize stress to the fish, the net would remain submerged, with the fish being concentrated close to the shore to facilitate netting. Any non-target species collected in the seines would be released either upstream or downstream of the collection area.
5. Using rubberized nets, the fish would be collected from the concentrated seine, and transferred to a waiting hatchery truck. Salinity of the water in the truck would be increased to approximately (10 ppt) by using instant ocean or equivalent in order to reduce stress on the transported fish (U.S. Fish and Wildlife Service, 2014), as well as treat any scale abrasions and/or lacerations that may have resulted from the netting.
6. Depending on the amount of fish captured during each seine and the capacity and transfer density in the truck, the procedure would be repeated until all of the visible fish in the capture area have been collected and/or maximum hatchery tank density has been reached (approximately one fish per gallon of hatchery tank water). However, if after several seines, the target density is not reached, the fish that have been collected in the hatchery truck will be transported to the release location noted below (in order to avoid stress related mortality).
7. The filled truck would then transport the fish to the discharge location, which would be located downstream from the upstream migration area, where it would be emptied (preferably by using the discharge pipe on the truck), or by netting the fish using a rubberized net, until all of the fish have been transferred.

Proposed Method of Capture for Post Spawned Adults (Alternative 2)

1. A debris rack would be installed upstream at the selected collection location (i.e. a point downstream of the historical spawning location in Leverett Pond). Prior to setting any nets, the proposed capture area would be cleared of large debris that could potentially snag the bottoms of the nets or traps preventing them from contacting the bottom of the river allowing fish to escape, as well as preventing the net's retrieval (i.e. when using a seine).
2. Just downstream from the debris trap, one or more fyke nets and/or hoop nets would be installed, with the wings extending to both sides of the river, and the trap oriented with its entrance facing upstream.
3. Each day, or several times a day during the outmigration season, the holding bag of the fyke net would be examined for the presence of adult blueback herring. This could be done either by wading or by using a small boat (the proposed capture area appears shallow enough to wade). Any non-target species collected in the nets would be released away from the trapping area. It should be noted that this net should be checked approximately every hour during the peak outmigration season, in order to prevent the impingement of exhausted downstream migrating blueback herring on the nets and resulting mortality.
4. The bag would be emptied into a floating live car, or holding tank on the boat, and the adults would be transferred to a waiting hatchery truck. This would be repeated until the truck has been filled, and/or there are no additional captured fish.
5. The fish would be transferred to the release area downstream from the work area, and released by opening the discharge pipe, or by netting using a rubberized net.

Proposed Release Location for Pre-spawning Adults in Leverett Pond

The captured pre-spawning adult blueback herring would be transported to Leverett Pond, and released at a proposed release area upstream from the River Road Bridge in Brookline. Aerial and ground level views of this location are shown in Figures 12 and 13. This section of Leverett Pond is downstream from the known blueback herring spawning habitat, and release at this location will allow the fish to continue their migration to the spawning area un-impeded. The area is accessible from the Emerald Necklace path off of Pond Ave.



Figure 12. Proposed Blueback Herring Pre-spawning Adult Release Area



Figure 13. View of Leverett Pond from Proposed Pre-spawning Adult Blueback Herring Release Area looking downstream toward Emerald Necklace Path Bridge.

Proposed Method for Release of Pre-spawning Adult Blueback Herring in Leverett Pond

1. The tank/hatchery truck would be directed to the proposed release area adjacent to Leverett Pond.
2. The discharge pipe would be extended to the water to a depth of approximately 3 feet.
3. The gate would be opened releasing the fish into Leverett Pond. Fish that remain in the tank would be netted and moved to the water.
4. Alternatively if there is no discharge pipe on the hatchery truck, the fish would be netted from the tanks and transferred to the Leverett Pond Release Area.

Proposed Release Areas for Post Spawned Adult Blueback Herring in the Muddy River

The preferred release location for these post spawned adult blueback herring would be at the farthest location downstream, just upstream from Storrow Drive (Figure 14). This area appears to have vehicle access, although it has not been confirmed. In the event that this area is not accessible, the post spawned adult blueback herring can be released just downstream from any of the proposed capture locations discussed previously. The capture locations (i.e. barrier nets, seines or traps) would be initially set up so that there would be sufficient space on their downstream side to allow the release of the post spawned adults. The locations of the capture areas were shown above in Figures 1-6. .



Figure 14. Proposed alternate release area for post spawned blueback herring adults.

Specifications for Hatchery Tank Trucks - Excerpted from USFWS (2014)

“The USFWS operates two trucks that carry a 750 gallon and a 1,000 gallon circular tank. Each tank has two water pumps and plumbing to provide both on-site water pick-up/filling and then switch to a closed/recycling flow, creating a circular flow in these tanks. Each truck also has oxygen that is applied at rate dependent on water temperature and fish density, generally at a rate of 4-6 mg/liter through fine grain air stones. Natural salt (water treatment brands) is applied prior to filling tanks with water to achieve approximately 10 ppt salt concentration when filled. A water quality multi-meter is used to monitor both salt concentration and dissolved oxygen levels. Data sheets to track number loaded, location, temperature, and other details are filled out on departure and also later at time of release.”

Work Plan

The fish capture/transport program will be implemented by a contractor supervised by the Corps of Engineers. The contractor will be required to develop and submit a detailed work plan to the Corps of Engineers, Massachusetts Department of Marine Fisheries, and NOAA Fisheries for review and approval. The work plan will be submitted for review no later than 3 months prior to the herring migration season.

Reporting

A report describing the results of the fish capture/transport program will be submitted yearly after the herring migration season (approximately July of any year) to the Massachusetts Department of Marine Fisheries and NOAA Fisheries.

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Appendix H
Muddy River Restoration Project
Maintenance and Management
Plan

THE MUDDY RIVER RESTORATION PROJECT MAINTENANCE AND MANAGEMENT PLAN

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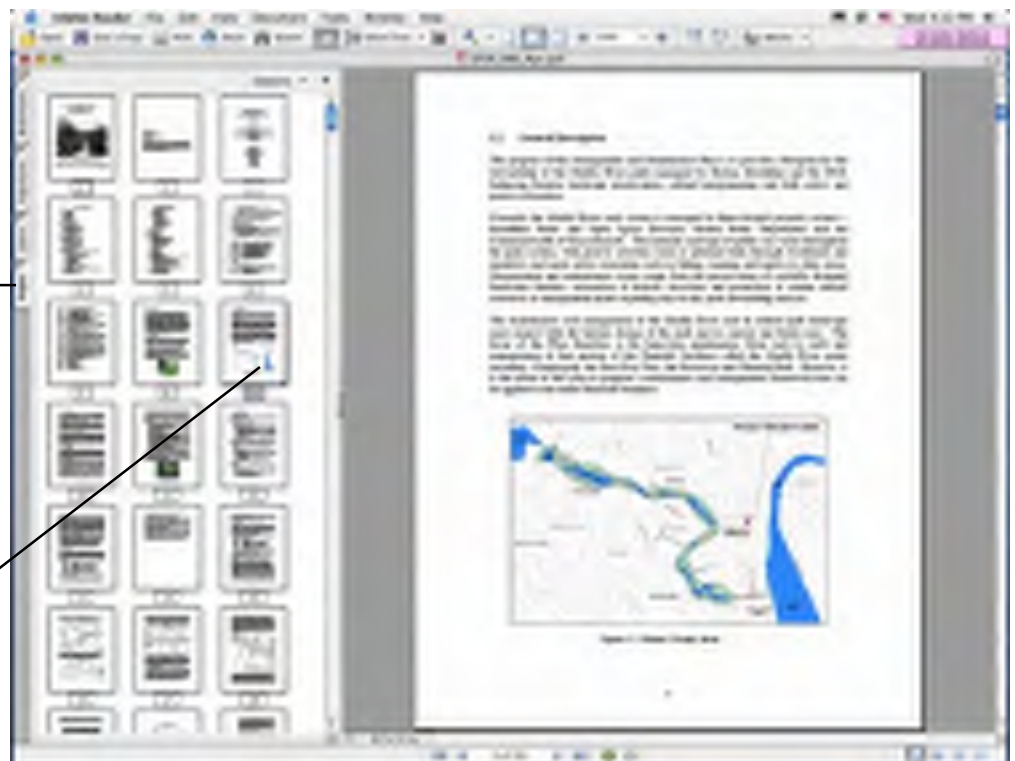


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THE MUDDY RIVER PARKS OF THE EMERALD NECKLACE



THE MUDDY RIVER RESTORATION PROJECT

MAINTENANCE AND MANAGEMENT PLAN

January 2005

City of Boston

Thomas M. Menino, Mayor

Town of Brookline

Robert Allen, Chair, Board of Selectmen

Acknowledgements

The Muddy River Management and Maintenance Plan has benefited from input of a variety of professionals and dedicated individuals. The City of Boston and the Town of Brookline would like to thank the following individuals, agencies and organizations for their contributions: Executive Office of Environmental Affairs, Division of Conservation and Recreation, the Muddy River Management and Maintenance Oversight Committee, the Muddy River Citizens Advisory Committee, and the Emerald Necklace Conservancy.

Muddy River Parks Management and Maintenance Plan

October 2004

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CHAPTER 1: INTRODUCTION

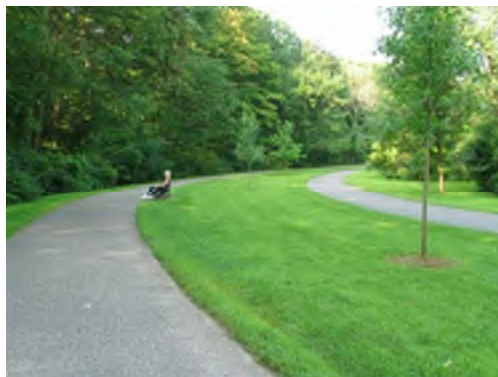
This Plan proposes a new and fully scoped maintenance program and management structure for the Phase I Muddy River Restoration Project [the “Project”]. As noted by the Secretary on page seven of the Draft Environmental Impact Report (DEIR) certificate, such a program and structure will prove critical for protecting the public’s investment in this historic property. The Management and Maintenance Plan for the Muddy River project is compatible and consistent with the requirements of the Secretary of Environmental Affairs in his Environmental Notification Form (ENF) Certificate, DEIR Certificate and Final Record of Decision (ROD). It also reflects the comments received from the numerous stakeholders and interested citizens on the DEIR (including the Emerald Necklace Citizens Advisory Committee) and Draft ROD. The Plan provides a higher level of maintenance that is both responsive to historic design intent and current use of the Muddy River parks system and outlines a new management structure that will ensure coordination and cooperation between project proponents as well as ensure a coordinated proponent response to oversight committees, agencies, park-related and greenspace organizations and the general public.

1.1 Vision Statement

The goal of this Management and Maintenance Plan is to implement a superior level of maintenance and an effective system of management for the Emerald Necklace’s Muddy River parks in order to ensure that the Muddy River Restoration Project meets its long-term goals and that the significant public investment in the project is adequately protected.

This plan will strengthen the ongoing coordination of Boston, Brookline, the Massachusetts Division of Conservation and Recreation (DCR), park staff, volunteers and park partners around management and maintenance of the park as well as the coordination of capital projects and the maintenance they require.

The success of the Muddy River restoration will depend upon the implementation of a long-term maintenance and management plan. As the landscape matures and further restoration projects are completed, the Plan will remain flexible and adapt to changing conditions and capital improvements.



Olmsted Park

1.2 General Description

The purpose of this Management and Maintenance Plan is to provide a blueprint for the stewardship of the Muddy River parks managed by Boston, Brookline and the DCR, balancing historic landscape preservation, cultural programming and both active and passive recreation.

Currently the Muddy River park system is managed by three distinct property owners – Brookline Parks and Open Space Division, Boston Parks Department and the Commonwealth of Massachusetts. The intensity and type of public use varies throughout the park system, with passive activities such as informal trails through woodlands and meadows and more active recreation such as biking, running and sports in other areas. Management and maintenance issues range from the preservation of carefully designed landscape features, restoration of historic structures and protection of unique natural resources to management issues regarding day-to-day park stewardship and use.

The maintenance and management of the Muddy River and its related park landscape must respect both the historic design of the park and its current and future uses. The focus of this Plan, therefore, is the long-term maintenance (from curb to curb) and management of that portion of the Emerald Necklace called the Muddy River parks including: Charlesgate, the Back Bay Fens, the Riverway and Olmsted Park. However, it is the intent of this plan to propose a maintenance and management framework that can be applied to the entire Emerald Necklace.

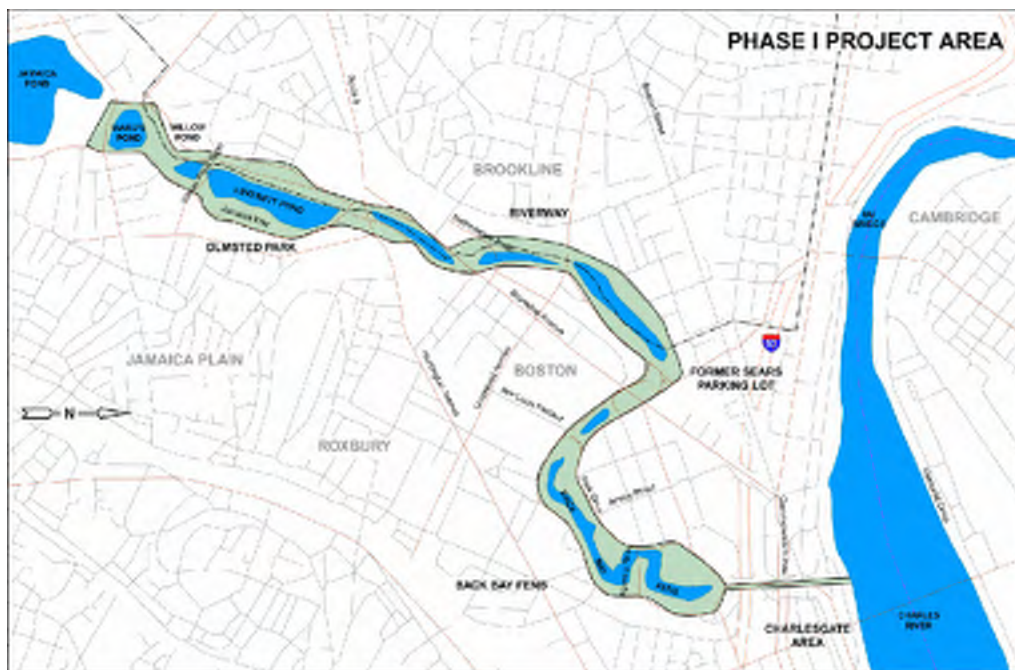


Figure 1.1 Phase I Project Area

1.3 Overview of Project

This report is a Management and Maintenance Plan for Charlesgate, the Back Bay Fens, the Riverway and Olmsted Park; four of the parks which have the Muddy River watercourse running through them and which are part of the six-park chain of the Emerald Necklace park system. It builds on the considerable inventory, analysis and recommendations that resulted from earlier works, most importantly, the recommendations of the Emerald Necklace Master Plan.

The most significant report, to date, for the park is the *Emerald Necklace Master Plan*, completed in 1989 and updated in 2001. Prepared by the Massachusetts Department of Environmental Management, now DCR, the Master Plan is the product of a decade of planning and extensive consultation with the many individuals and groups who have a special connection to the Emerald Necklace parks.

Currently, planning is underway to initiate one of the most ambitious and comprehensive historic landscape preservation projects in the nation. Through a partnership with the state, federal government and private sector, Boston, Brookline and the DCR will embark on a multi-million dollar effort to ensure the long-term preservation of the park system by providing flood control, improving water quality, enhancing habitat and restoring the historic landscape. The Muddy River Management and Maintenance Plan is designed as a tool to preserve, protect and enhance the capital improvements of the Muddy River Restoration Project Phase I.

1.4 The Olmsted Legacy

The Emerald Necklace Master Plan states that the park system still reflects much of Olmsted's original design from the Back Bay Fens, along the Muddy River to Leverett, Willow, Ward's and Jamaica Ponds and on to the Arnold Arboretum and Franklin Park. In the early 1970s, citizens from Boston and Brookline became alarmed at the level of park deterioration they observed in their communities. Their advocacy brought to the public's attention the plight of our urban open spaces, and the historic importance of the Emerald Necklace parks, a legacy that includes over 1,000 acres and about half of Boston's present park system.

While today the subtle plantings along the water's edge are gone, commuter traffic speeds along parkways designed for pleasure-driving carriages, and municipal maintenance forces are only a fraction of their former size, the Emerald Necklace is still an extraordinary and special place within the city – a succession of carefully orchestrated views of meadows, woodlands and watercourse which delight park visitors. The parks provide rich recreational opportunities, including jogging, fishing, picnicking, softball, gardening, and outdoor theater.

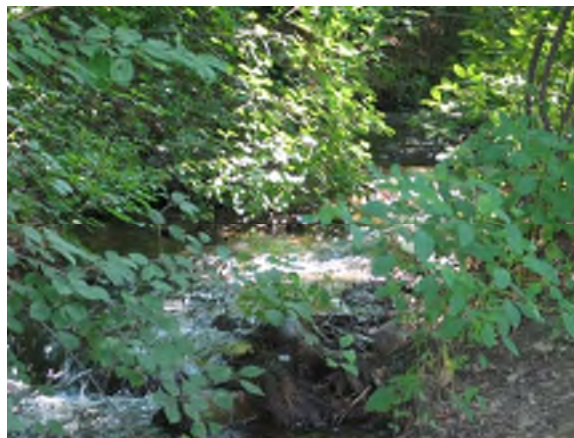
One hundred years ago, civic-minded leaders, supported by strong public sentiment, led a park movement that created the Emerald Necklace park system. They foresaw the need for passive green space and natural environmental features, such as stream valleys and

upland reservations, in their expanding urban areas. They implemented a massive public works engineering effort, while transforming the landscape into a recreational haven. Today's park advocates are driven by the same commitment to urban natural resources.

This Management and Maintenance Plan addresses the recommendations set forth in the *Emerald Necklace Master Plan* which were intended to reinforce Olmsted's original concept of a unified system of linked parks through the following actions. The goals of this Plan are to:

- Re-establish the visible continuity of the watercourse and restore the character of the original intent of a "chain of pleasant waters".
- Strengthen the linkages between the parks to recapture as much uninterrupted movement as possible through them.
- Reintegrate the parkways as a primary circulation element in and among the parks, as scenic pleasure routes.
- Reinforce unity, variety, and health of vegetation. Express "*distinctive*" landscapes of upland forests, "*alternating groves and meads*" of the middle section and the lowland landscapes of the Fens, which were once a marsh, but now, a landscape bordering a "*winding, meandering watercourse*".
- Enrich the wildlife supporting capacities of the park system.
- Accommodate the widest range of recreation needs for the broadest constituency of users that are not inconsistent with the Emerald Necklace's unique character as a passive, water related, linear park.
- Coordinate the energies of Boston, Brookline, the DCR, the institutions (both within the parks and abutting) and volunteer groups into a cooperative public/private restoration and preservation effort.
- Strongly support the improvement of water quality in the Muddy River as a concerted public/private effort. (*Emerald Necklace Master Plan, 2001*)

The Muddy River Restoration Project involves a wide range of physical improvements and management practices that will produce flood control, water quality improvements, habitat enhancement, landscape restoration, and stormwater best management practices. The Project constitutes the first phase in the long-term restoration of the entire Emerald Necklace park system in Boston and Brookline.



1.5 Goals and Objectives

The following is a summary of the goals and objectives for the Muddy River Parks Maintenance and Management Plan.

Goal #1

Promote the enhancement, protection and preservation of the historic and natural landscape of the Muddy River park system.

Objectives

1. Rehabilitate and maintain the historic landscape and extant historic features in an appropriate and sensitive manner.
2. Develop treatment recommendations that preserve and respect the historic and natural landscape features, circulation patterns, uses and structures that have been determined through research and documentation to be integral components of the Muddy River landscape.
3. Minimize alterations or additions that are not consistent with the historical integrity of the property while also recognizing contemporary needs and community priorities.

Goal #2

Provide a framework for ongoing management and maintenance of landscape features, uses and structures that will guide park managers, administrators and park partners who are responsible for or will be involved in the care of the Muddy River parks.

Objectives

1. Develop a maintenance plan for the vegetation and historic landscape of the Muddy River.
2. Provide guidelines for the use, rehabilitation and maintenance of the historic structures in the parks.
3. Prioritize projects for implementation by park partners.
4. Analyze existing staffing and provide recommendations to realize an increased maintenance standard.
5. Develop a budget that will support a higher standard of maintenance.

Goal #3

Promote the stewardship, use and awareness of the Muddy River parks as a unique historic landscape.

Objectives

1. Support ongoing efforts of volunteer and community groups in preserving the historic landscape of the parks.
2. Develop educational programs that reflect the significance and variety of resources within the Muddy River landscape.
3. Promote compatible recreational uses for the parks.

1.6 Methodology

The Maintenance and Management Plan submitted as part of the Muddy River FEIR was written as a requirement of the Massachusetts Environmental Protection Act [MEPA] permitting process for the Muddy River Restoration Project. ETM Associates, L.L.C. was hired to write the maintenance plan for the Muddy River parks of the Emerald Necklace Muddy River Restoration Project. ETM analyzed the current park maintenance responsibilities, classified the physical areas in the park system, measured the workload, evaluated performance and set a higher maintenance standard with the appropriate workforce based upon the landscape maintenance standards at the Arnold Arboretum. The Plan was developed by the custodians of the parks with assistance from Pressley Associates, Camp Dresser and McKee, Inc., ETM Associates, L.L.C., the MA Division of Conservation and Recreation, the Muddy River Management and Maintenance Oversight Committee and others. The Plan was further expanded to incorporate an appropriate historic preservation framework.

The Methodology used to develop the Muddy River Management and Maintenance Plan of the SFEIR follows the benchmarking standards developed by the National Recreation and Park Association, the Professional Grounds Management Society and the Secretary of the Interior's Standards for the Treatment of Historic Properties, which define the preservation approaches for historic properties and provide general guidance for acceptable treatment work. The methodology for specific maintenance analysis or management approaches is more fully described in the respective chapters.

1.7 Park Sectors

The Muddy River parks of the Emerald Necklace are addressed both as an entire system and as individual sectors. The Muddy River parks have been divided into 7 sectors for analysis, maintenance planning and implementation purposes – taking into account maintenance needs and the historic and physical characteristics of the areas. The analysis of the park in terms of park sectors allows for the careful consideration of the unique features, opportunities and constraints within each individual park. The 7 park sectors are as follows:

Sector I:	Charlesgate
Sector IIA:	Back Bay Fens North: Victory Gardens/Mother's Rest
Sector IIB:	Back Bay Fens Central: Rose Garden/Clemente Field
Sector IIC:	Back Bay Fens South and Sears Parking Lot
Sector III:	Riverway
Sector IVA:	Olmsted Park North: Leverett Pond/Daisy Pond
Sector IV B:	Olmsted Park South: Wards Pond/Willow Pond/Nickerson Hill

1.8 Previous Studies and Plans

The Plan includes several appendices that supplement information within the report. The Plan provides an updated maintenance and management strategy for the Muddy River

parks, building on the current management approach as well as considerable inventory, analysis and recommendations from previous plans and studies.

In addition, the following studies and plans have been used or referenced to aid in the management and maintenance plan for the Muddy River parks.

Maudslay State Park: Management and Maintenance Plan, Newbury Port, Massachusetts, Volume I, (Prepared for the Department of Environmental Management: Bureau of Project Planning, Design and Development), Pressley Associates, Inc. 432 Columbia Street, Cambridge, MA, April 2003

Maintenance Plan for the Emerald Necklace-Muddy River Parks, Muddy River Restoration Project, (prepared for the Boston Parks and Recreation Department, Town of Brookline Parks and Open Space Division and Metropolitan District Commission), ETM Associates, L.L.C., January 2003

The Emerald Necklace Parks, Master Plan, (prepared for the Commonwealth of Massachusetts), Pressley Associates, Inc. 432 Columbia Street, Cambridge MA, April 2001

CHAPTER 2: HISTORIC OVERVIEW

The Muddy River Parks are cultural and historic landscapes. As defined by the National Park Service, a cultural landscape is “a geographic area associated with an historic event, activity, or person or exhibiting other cultural or aesthetic values.

2.1 Introduction

With a cultural landscape such as the Muddy River parks it is important to document the property’s history before making recommendations for physical change in order to fully understand which features, materials and spaces contribute to its historic significance and thus ensure they are not inadvertently lost or damaged. The challenge is to preserve, rehabilitate, restore or replace character-defining features from the past, while simultaneously adapting the property for present day use.

The Muddy River parks of the Emerald Necklace have been divided into 7 sectors for analysis and planning purposes. These are:

Sector I:	Charlesgate
Sector IIA:	Back Bay Fens North: Victory Gardens/Mother’s Rest
Sector IIB:	Back Bay Fens Central: Rose Garden/Clemente Field
Sector IIC:	Back Bay Fens South and Sears Parking Lot
Sector III:	Riverway
Sector IVA:	Olmsted Park North: Leverett Pond/Daisy Pond
Sector IV B:	Olmsted Park South: Wards Pond/Willow Pond/Nickerson Hill

2.2 Historic Resources – Sector I – Charlesgate

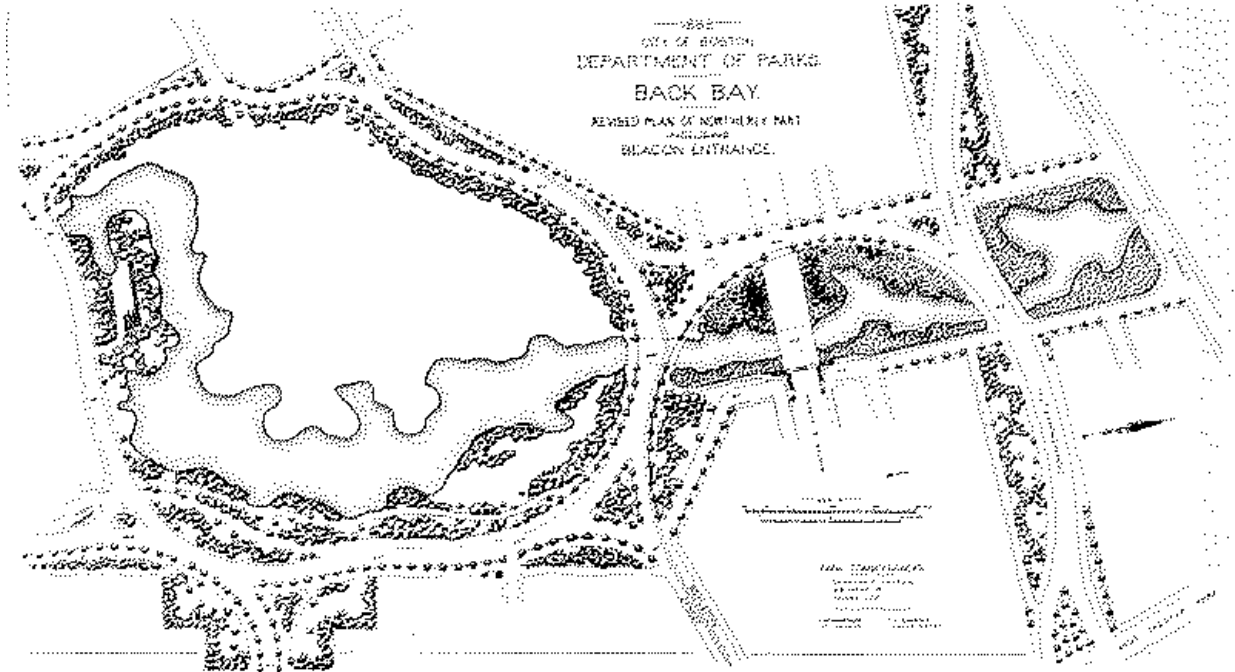
Historically, the Charlesgate area has a Primary Period of Significance of 1878-1895, which is the Frederick Law Olmsted design period for the area as documented by drawings from 1879 to 1896. Olmsted referred to this area as the "Beacon Street Entrance".

The 1879 "Proposed Improvement of Back Bay" plan shows Beacon Street, Commonwealth Avenue and the Boston and Albany Railroad Bridge crossing over the Muddy River. The railroad passes under a road (Charlesgate West) that connects Commonwealth Avenue to Boylston Street and Audubon Road (Park Drive) in an area that is referred to as Gaston Square. The Olmsted period drawings continue to show Commonwealth Avenue as a curving roadway with informal plantings, not as a formal, straight avenue. During this period the formal avenue with four rows of trees in the median and a single row of trees at both adjacent sidewalks starts at Charlesgate East and continues East.

The Fens, as the Back Bay was known, was a salt creek bordered by salt marshes that emptied into the tidally affected Charles River. Construction of the Charles River tidal gates began in 1881. They were ready for operation in 1882. The Muddy River Conduit

to the Charles was introduced in 1883. The "Back Bay Revised Plan of the Northerly Part including Beacon Entrance" illustrates the 1882 condition (see Figure 2.1).

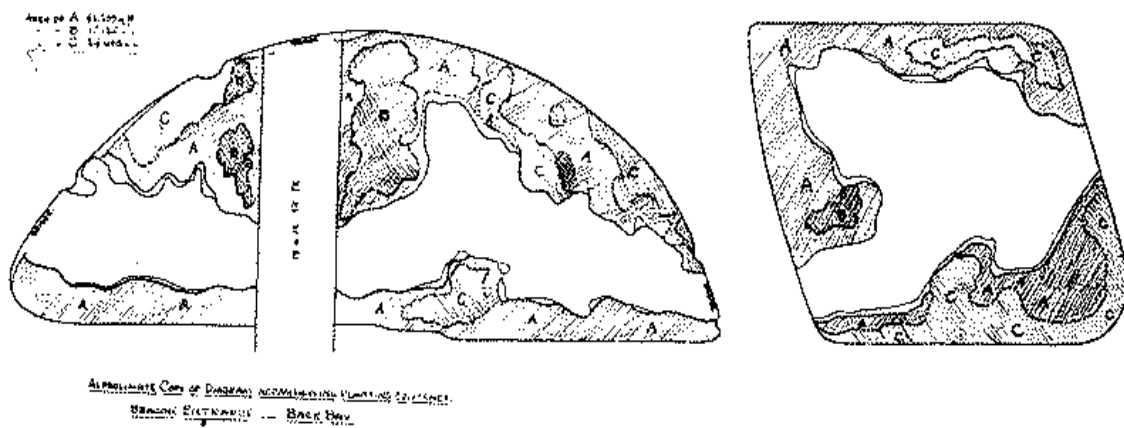
Figure 2.1
Back Bay Revised Plan of the Northerly Part including Beacon Entrance, 1884



Source: FLONHS

Planting design in this area is documented on the 1884 Planting Plan for the Beacon Street Entrance (FLONHS). A planting list compiled from several sources is provided by Cynthia Zaitzevsky in Frederick Law Olmsted and the Boston Park System, page 188 (see Figure 2.2).

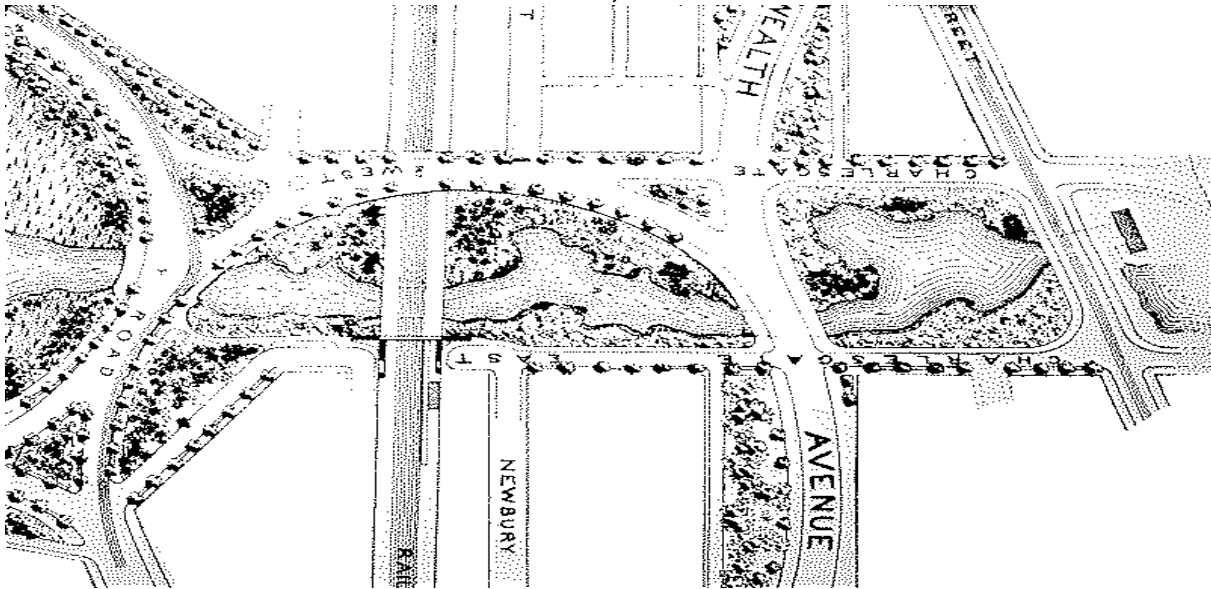
Figure 2.2
Planting Plan for the Beacon Street Entrance, 1884



Source: FLONHS

Even though the quantity of vegetation planted was extensive by 1885 and 1886, it was obvious that, with the exception of some upland vegetation, which survived, the majority of the plantings did not. A second planting that is undocumented, except for photographic evidence in 1896, seems to have been successful. The 1887 Lithograph of Olmsted's design, below, illustrates the conditions when the river was still tidal (see Figure 2.3).

Figure 2.3
Map of the Back Bay Fens, Commonwealth Avenue, Beacon Street and Audubon Road,
Dec. 3, 1887



Source: FLONHS

Grading for the area and the establishment of the shoreline are documented on two grading studies by John C. Olmsted and Warren Manning in 1882 FLONHS #923-52 and FLONHS #930-81. Photographic documentation for Charlesgate is limited for the Olmsted Period. The Secondary Period of Significance for the Charlesgate Area is 1910-1931. The Arthur A. Shurtleff design for the area is documented by a series of studies by Shurtleff from 1912 to 1931 that modify the Olmsted design for Commonwealth Avenue and part of the waterway. The proposals straightened the avenue from Charlesgate East to the Beacon Street intersection to the west and continued the rows of trees east of Charlesgate East (see Figure 2.4).

The documentation includes studies of the median width and MTA (MBTA) redesign of minor adjacent roads, and the construction of new bridging with balustrades in the formal classical style, completed by 1925. There also was a series of designs for a "Boat Haven" at the Charles River below the gates and studies of a proposed overpass connector from the Charles River Parkway (Storrow Drive) to Gaston Square at Boylston Street over the Muddy River. These elements were not completed. Drawings in 1928 and 1931 show informal and formal schemes for the never-completed connector overpass.

In 1919, the Metropolitan Park Commission and the Massachusetts Water and Sewer Commission were merged to form the Metropolitan District Commission (MDC), combining the Metropolitan Parks and Parkways' responsibilities with the function of water supply and sewerage for the state. The MDC prepared a series of studies from 1949 to 1957 that culminated in the 1963-64 construction of the current Bowker Overpass designed to connect James J. Storrow Memorial Drive (i.e., the Charlesgate Interchange) to Audubon Road (Park Drive). The MDC began this modification process with the taking of the Fens parklands from Beacon Street to the Charles River in 1950. The major overpass, as developed, impacts both light and water in this area and creates isolated areas that cannot be viewed from the adjoining streets. The homeless have occupied these isolated areas over time.



Figure 2.4
Charles River Basin Preliminary Plan

BPRD Arthur A. Shurtleff, 1931

In 1952, Chapter 354 of the General Acts authorized the Massachusetts Turnpike Authority to take lands for the Massachusetts Turnpike (I-90) Extension into downtown Boston. The taking was parallel with the railroad right of way at Charlesgate. Completed in 1962, the taking included the width of the Fens between the Railroad Bridge and Commonwealth Avenue. The Richardson Iron Railroad Bridge, constructed in 1880 was destroyed as part of this taking. The Commonwealth Avenue and Beacon Street Bridge were restored in the 1980's. The arches and historic balustrades were restored. On April

25, 1978, Commonwealth Avenue Mall, including Charlesgate, was designated a Landmark by the City of Boston, under Chapter 772 of the acts of 1975. Charlesgate is contained within the Back Bay Historic District of National Register of Historic Places.



Figure 2.5
Charlesgate East and West, Arthur A. Shurtleff, 1930's
Source: BPL

2.3 Historic Resources – Sector IIA, IIB, IIC – Back Bay Fens

The Back Bay Fens has a Primary Period of Significance of 1878-1895, which is the time of Frederick Law Olmsted's design of the park in that area, and its construction. Plans and working drawings in the archives of the Olmsted National Historic Site (FLOHNS) document the development of the park by the Olmsted firm during this period. The most significant of these are the published plans, "Proposed Improvement of Back Bay" (1879), "Map of the Back Bay Fens, Commonwealth Avenue, Beacon Street and Audubon Road" (1887), and "Plan of Portion of Park System from Common to Franklin Park (1896). Numerous nautical charts and an 1878 survey in the archives of the Olmsted National Historic Site titled "Topographic Plan for Back Bay Fens showing Gravely Point" show that virtually all of the islands and peninsulas within the basins of the Fens were created by dredging according to Olmsted's plans. A survey of 1921 documents the Olmsted as-built design, as well as showing where filling of the Fens had occurred in the intervening period.

The 1879 design illustrates a winding stream flowing through a salt marsh. In fact, Olmsted's design intent was to create the feeling of a restored natural salt marsh, but he also introduced a wider variety of plant species than would have grown naturally in the area (see Figure 2.6).

Figure 2.6
Proposed Improvement of Back Bay, 1879



Source: FLONHS

As Olmsted explained in his "Paper on the Back Bay Problem and Its Solution" of 1886, he planned the naturalistic landscape of the public park in the Fens as an alternative to the traditional stone-lined holding basin with which similar problems of sewerage and storm-water control were solved elsewhere. (See the Papers of Frederick Law Olmsted, Supplementary Series, Volume 1, pp. 437-59.)

"The landscape created according to Olmsted's plans was that of a salt marsh of the region, although he used a wider variety of plants than would have grown naturally in the area. In addition to islands and peninsulas that rose up to four feet above the high tide level, Olmsted planned the landscape with extensive low islands planted with sedge that, in addition to their scenic purpose, were intended to prevent development of surf that would undercut the banks during times of high winds and heavy rain when the floodwaters of Stone Brook would be diverted into the Fens basin. The narrow, curving waterway, in addition to providing landscape interest,

provided no place where storm winds could build up heavy surf. Olmsted's plan also included a complex circulation system of drives, walks and bridle paths that would make the landscape accessible to a variety of users. While conceiving the recreational purpose of the area to be primarily the enjoyment of the salt-marsh scenery, Olmsted also provided for boating, including a circuit for large launches serving as public water buses. He also proposed that the park serve a scientific purpose, as a site for a collection of aquatic birds and fish.

Thus the Back Bay Fens was designed and constructed to serve a variety of recreational and educational purposes, while at the same time solving difficult and serious problems of sanitary engineering."

It was in fact a designed "naturalistic" landscape very different from the tidal flats that were the natural condition of the site when Olmsted began his work. The 1911 "Thirty-Sixth Annual Report, Board of Commissioners, Department of Parks Boston, Massachusetts" includes the following quote by Frederick Law Olmsted, Jr.

"The landscape design of the Fens was to create a salt creek bordered by salt marshes enclosed by high banks intended to be covered with wild flowers, low compact shrubs, vines and creepers, and scattering trees enough with the street trees to fairly well screen the future adjoining houses, but not enough to unduly shade out the ground cover. There are to be found many examples of this type of landscape where the little freshwater rivers of New England come to the sea level and mingle with keen delight by artists and lovers of natural scenery, but probably never before conceived of as a thing to be imitated in laying out a public park" (see Figure 2.7).



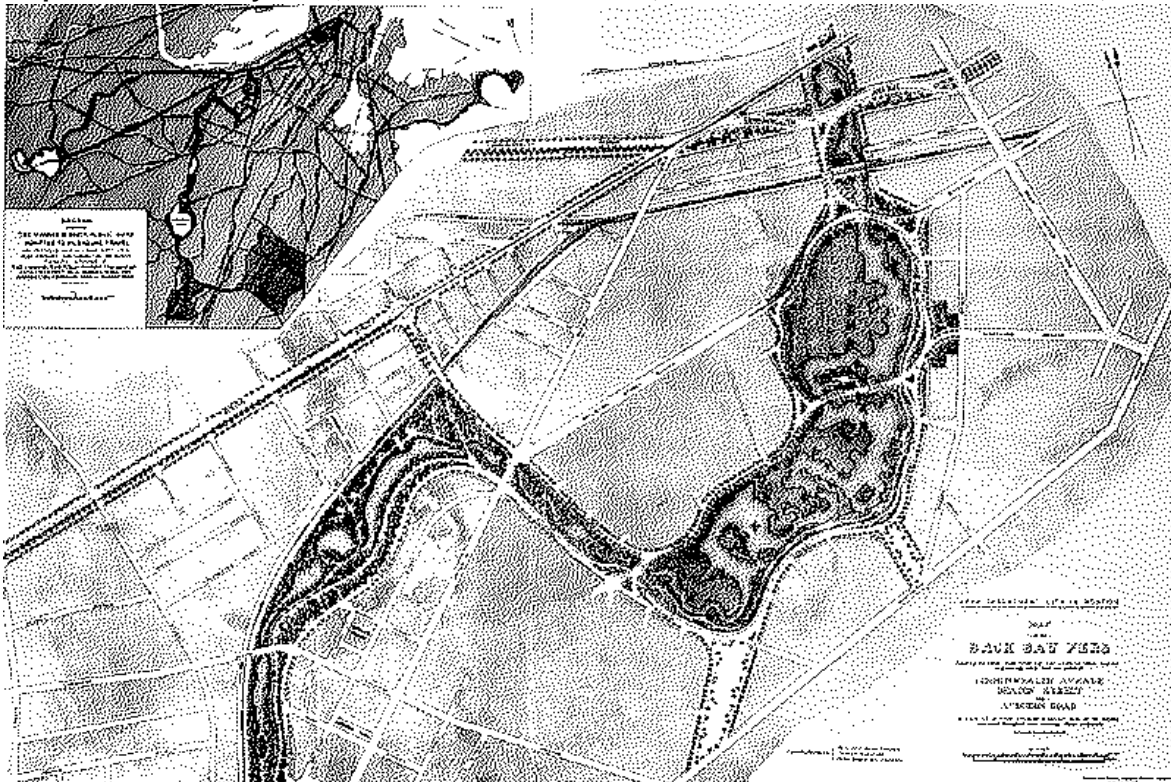
Figure 2.7
View of Back Bay as a Tidal Basin, 1890's

Source: Frances Loeb Library HGSD

Photographic documentation for this period, some documentation from planting plans for the northern basin, by W.L. Fischer, c. 1885, and plant lists exist. The plant lists principally include trees, although thick plantings of shrubs in both the northern and southern basin can be seen in both the photographic documentation and extensive marsh grasses. Plants that were believed to be salt-tolerant were selected.

Three bridges were included in the design; the Boylston Street and Agassiz Road Bridges for street traffic, and the Fens Bridge (at Avenue Louis Pasteur/Higginson Circle) for foot traffic. Olmsted also introduced a sewer interceptor and associated gatehouse to control stormwater runoff from Stony Brook into the Fens. The gatehouse and conduit were completed in 1882. In 1883 the Muddy River Conduit to the Charles River at Charlesgate was introduced. The 1887 lithograph of the Olmsted plan illustrates the park as completed by Olmsted (see Figure 2.8).

Figure 2.8
Map of the Back Bay Fens, Commonwealth Avenue, Beacon Street and Audubon Road, 1887



Source: FLONHS

In 1886 the Stony Brook flooded 63 acres of lower Roxbury causing extensive damage. As a result, by 1897 the New Stony Brook Conduit (The Commission's Channel) was constructed, bringing pollution into the Fens basin and resulting in offensive conditions. In 1889, the Fens was dredged to remove sludge deposits and foul odors. In 1903 The Commissioner's Channel was extended, a second Gatehouse was constructed and the 1882 Gatehouse was relocated.

The 1921 survey documents the grading and the shrub and tree massings from the Olmsted Period. It also shows the 1900 to 1920 gradual filling of the marshes under Commissioner John Pettigrew. In 1908, fill materials from subway excavations in Boston were dumped and graded in the Fens for ball fields. Pressure to provide spaces for organized active sports and for playgrounds and the need to find a place to dump excavation material resulted in further filling. This survey and other historical plans allow us to determine the line of the shore by the end of the Olmsted Period, as well as plant massings on the shoreline.

The Secondary Period of Significance is 1910-1933, during which Arthur A. Shurtleff redesigned much of the area. In addition to extensive filling of the basins, the water changed from salt to fresh, facilities for recreation were introduced into the landscape, along with ornamental gardening in the form of the James Michael Curley Rose Garden, and non-recreational functions such as the Fire Control Center.

Shurtleff, hired as a landscape consultant in 1910, prepared a Revised General Plan in 1921 in consultation with Olmsted Brothers. The plan illustrates a meandering fresh water river, which appears to be similar to Olmsted Senior's design for the Muddy River Improvement. The 1921 plan also illustrates the development of a rotary at Westland Avenue (see Figure 2.9).

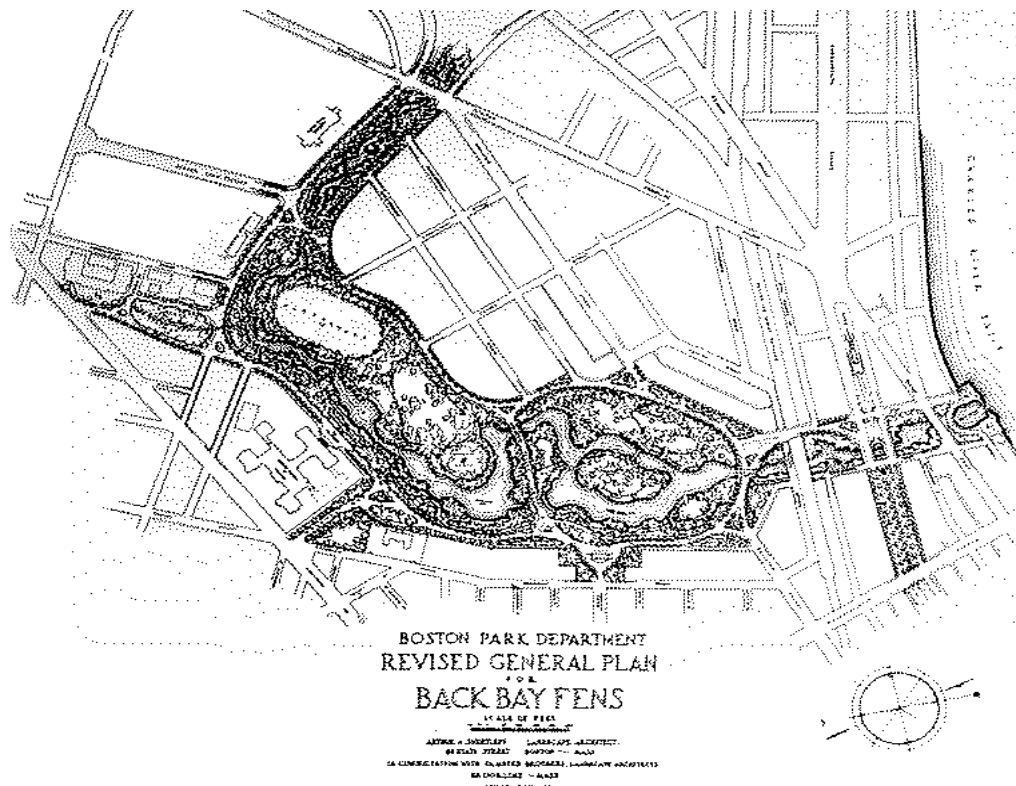


Figure 2.9
Revised General Plan for Back Bay Fens

Arthur A. Shurtleff, Nov. 1921
Source: FLONHS

From 1915 to 1922 a series of studies were conducted by Shurtleff for the Jersey Street Extension. A lagoon reflecting basin opposite the Museum of Arts Evans Wing was completed in 1927 and included two nearby wooden footbridges and a third wooden footbridge further to the south at Evansway (see Figure 2.10).

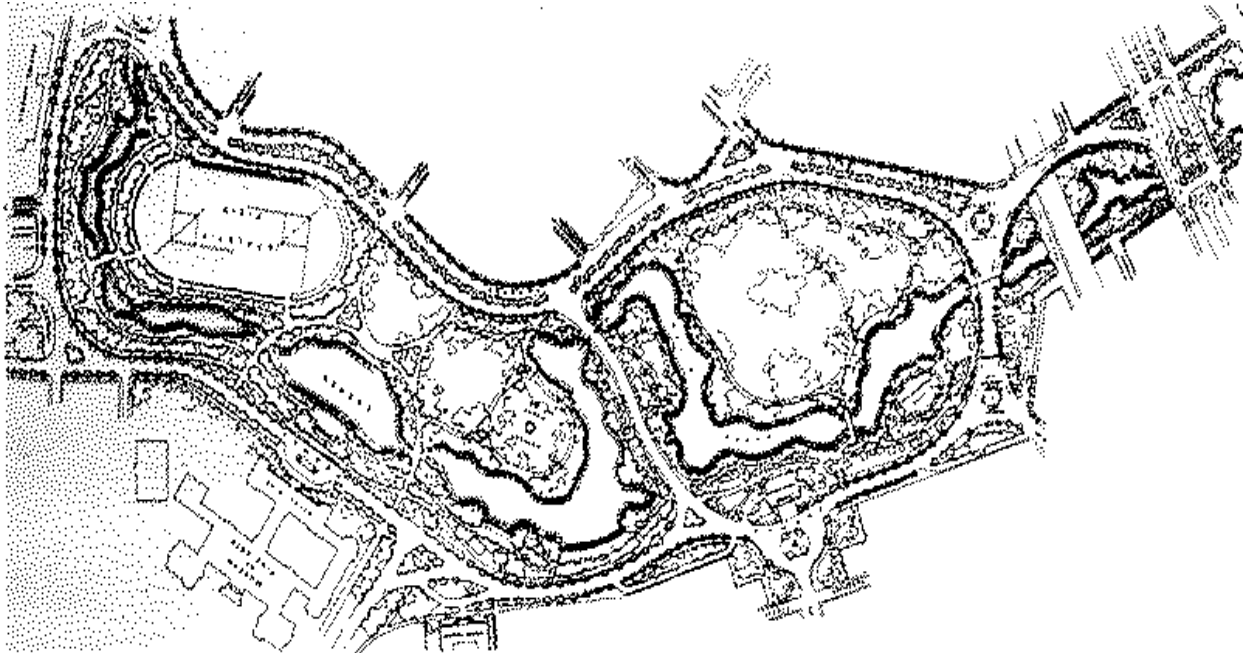


Figure 2.10
Revised General Plan for Back Bay Fens

Arthur A. Shurtleff, 1926
Source: FLONHS

In 1926, Shurtleff completed the Update to the Revised General Plan. The plan was followed by the intrusion of the Fire Control Center in 1927, the filling in the North Basin in 1927, the Field House and Stadium in 1929, modification of the lagoon in 1927 and again in 1930, and the Rose Garden by 1933.

Increased use of the parkways or pleasure drives of the park system as part of the commuter system for an expanding city resulted in the loss of parklands to accommodate wider roads. Audubon Road (Park Drive) and the Fenway Parkway were widened and straightened resulting in the loss of parkland during 1925-1926 (see Figure 2.11).

The Fens no longer had the appearance of a salt marsh; it had lost its distinctive landscape character and had become scenically part of the Muddy River with interspersed elements of ornamental gardening. In significant areas, active sports replaced the quieter and more landscape-oriented uses for which Olmsted had created his design.



Figure 2.11
Excavating, Dredging, Filling and Loaming in the Fens
 Arthur A. Shurtleff, March 24, 1927
 Source: BPRD

Historical plans help to determine the line of the shore by the end of the Shurtleff Period, as well as plant massings on the shoreline. It is also possible to overlay the shoreline for the Primary and Secondary Periods of Significance and the existing condition to determine what area of shoreline is extant from each period. An aerial photo documents and confirms the filling of what is now the Victory Garden area and the shoreline prior to the invasion of *Phragmites* (see Figure 2.12).



Figure 2.12
Aerial Photo Overlooking the Victory Garden Area

Fairchild Aerial Survey Inc., 1926
 Source: BPL Print Room

The Fens continued to change after the Shurtleff Period. The Victory Gardens were introduced into the North Basin fill area in 1940 and the World War II Memorial was added between the Agassiz Road Bridge and the Rose Garden. The area in the park set aside for war memorials was placed under the control of the White Fund, which during 1987-1990 restored the World War II Memorial and additional Memorials for the Korean and Vietnam Wars.

In 1956 the MDC took care and control of the Fenway, Park Drive (Audubon Road), Agassiz Road and Boylston Street as well as a twenty-five (25') foot taking of a right of way into the parkland. Between 1956 and 1982, parkland was taken for road widening, by-passes, turn-arounds and parking, while commuter traffic continually increased, isolating the Fens within a major roadway system. In 1958-1959 the taking of land above the Fens at Brookline Avenue for the Sears Roebuck Company cut into the Fens for a turn-around, demolished the gatehouse and headwalls at Brookline Avenue and filled the Muddy River. Additional filling of the Muddy River occurred at the Fens Bridge and the headwall of the bridge was filled in the process for a new road configuration that was never completed. Historical plans provide information on shoreline location as well as plant massing along the shoreline prior to the filling. The basketball courts were added between the stadium and Rose Garden in the 1970's.

In 1971 The Back Bay Fens was placed on the National Register of Historic Places along with all of Olmsted's Emerald Necklace Parks and on November 1, 1983, the Fens was designated a Landmark by the City of Boston.

Projects completed in the Back Bay Fens since the adoption of the Emerald Necklace Master Plan are documented in the Emerald Necklace Master Plan.

2.4 Historic Resources – Sector III – Riverway

The Riverway area has a Primary Period of Significance of 1880-1895, which is the Frederick Law Olmsted design period for the area between Brookline Avenue at the Fens to Route 9 in Brookline.

In 1880 Olmsted completed a plan titled "Suggestion for the Improvement of Muddy River, which was published in the Sixth Annual Report of the Boston Park Commissioners and in the Annual Report of the Brookline Park Commissioners. The suggested improvement included a diagrammatic plan for the proposed park prior to the 1881 design plan. Frederick Law Olmsted sets forth his intent:

"Except where the valley is now narrowest, it would be reduced in width by artificial banks, so that the river with its shores would everywhere have a general character, resembling that which is now near Longwood Bridge, only that its water would be kept at a nearly uniform level, and guarded from defilement by intercepting sewers and otherwise. The Brookline margin would be the broadened base of the present railroad embankment, bearing a woody thicket. The opposite on Boston bank would have an elevation above the water of ten feet, rising where the natural bank is used to twenty feet. Upon this will be laid out a public way ninety feet wide in continuation of that now forming along the Back Bay Basin, divided like that into foot, carriage, and saddle courses, and designed to serve as a public promenade along the river bank, as well as a trunk line giving an element of continuity to the street system of the neighborhood"

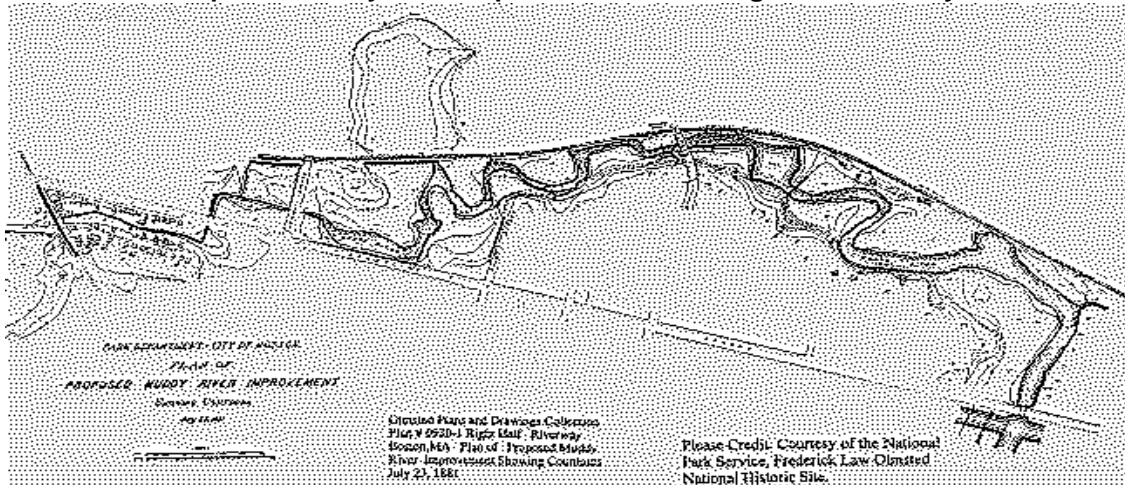
John Charles Olmsted discussed the issue of a manmade landscape in a 1904 report:

"Practically everything seen in this picture, which is typical of many portions of the Riverway, was artificially created in accordance with plans of the designers. Only the larger trees, in the distance and on the left, existed at the time, substantially as they now appear. The various ...were designed in collaboration with different architects. This beautiful and popular water park represents the transformation of what was once an ugly, neglected, and unsanitary stream."

A July 23, 1881 survey titled "Plan of Proposed Muddy River Improvement Showing Contours," prepared by Boston City Engineer Henry M. Wrightman, documented the site prior to the commencement of Olmsted's work. The Riverway site was in fact part of the

estuary of the Muddy River and contained salt marsh grasses and salt-water resistant shrubs. It was impacted by runoff water, a public health problem, and was a generally derelict area. The creation of the park required a change to the boundary between Boston and Brookline transferring the new boundary principally down the center of the river (see Figure 2.13).

Figure 2.13
Plan of Proposed Muddy River Improvements Showing Contours, July 23, 1881

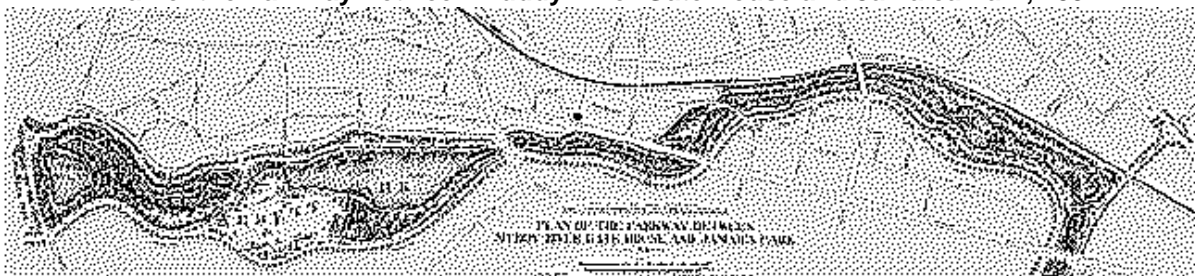


Source: FLONHS

The 1892 lithograph titled "Plan of the Parkway between Muddy River Gate House and Jamaica Park", and the 1896 "Plan of Portion of Park System from Common to Franklin Park" document the park during the Olmsted Period. In addition, a series of plans dating 1890 to 1893 provide detailed proposed grading, historic shoreline, plant massings with viewsheds, plant lists, and planting plans for the Olmsted design.

The 1892 design plan illustrates a winding fresh-water stream described by Olmsted as *"fresh water course bordered by passages of rushy meadow and varied slopes from the adjoining upland; trees in groups diversified by thickets and open glades"* (see Figure 2.14).

Figure 2.14
Plan of the Parkway Between Muddy River Gate House and Jamaica Park, 1892



Source: FLONHS

Olmsted's design intent was to create a landscape with the character of a New England fresh water stream. The entire streamway was re-graded and replanted to produce a

landscape that, while appearing natural, was the product of careful design, engineering, and construction. Both the Olmsted firm's plans and historic photographs show how completely the site was transformed in the process.

Although the basis of Olmsted's plantings was the trees, shrubs, and ground cover of the region, he supplemented them with non-native plants in order to enrich the landscape effect and produce a more powerful experience. The dominant figure on the Brookline Park Commission was Charles S. Sargent, with whom Olmsted had collaborated in planning the Arnold Arboretum. Sargent objected to Olmsted's proposal to use non-native plants, as well as plants that Sargent considered too floral and ornamental. Accordingly, Sargent removed a number of plants from Olmsted's list in the spring of 1892, some of which were restored. The Olmsted firm's less detailed planting plans and lists for the Boston side of the Muddy River reflect their desire to use a wider range of plant materials than Sargent would permit on the Brookline side, while retaining an overall unity of landscape character between the two sides of the river (see Figure 2.15).



Figure 2.15
Riverway Under Construction, 1892

Source: FLONHS

Extensive photographic documentation exists for the park, starting with construction photographs in 1891 and 1892 and continuing up to 28 years after its completion. These photos illustrate how the shoreline of the river was constructed and how the plantings and original bank treatments, either planted or grass beaches, progressed down to the edge of emergent vegetation (see Figure 2.16).



Figure 2.16
View Upstream from Longwood Bridge, 1920 (28 years after construction)

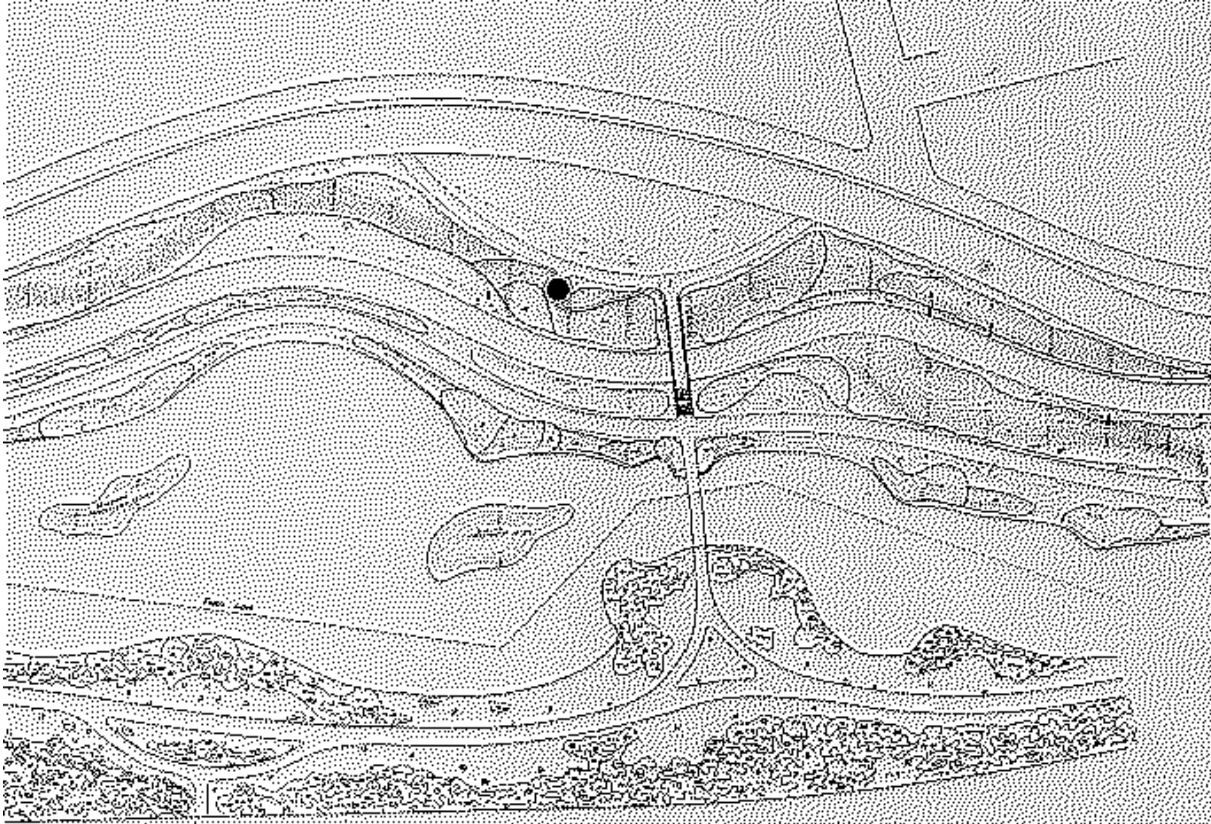
Source: FLONHS

Complete grading plans that delineate the grading and layout of the original shoreline have been examined. Overlaying the shoreline for the Primary Period of Significance with existing conditions aids in determining what area of shoreline is extant from that period. Extensive drawings exist which document the planting that occurred over the grading plan areas, including massing and viewshed diagrams, planting plans, and the above mentioned plant lists. Drawings of the Brookline side show detailed plant placement, while the documentation of the Boston side illustrates massings with general lists of species to be planted. No other park designed by the Olmsted firm during Olmsted's career and with his active participation has nearly as detailed a record of planting intent. Planting plans for the Muddy River Restoration project from the Olmsted Archives are provided in Appendix D.

The planting plans and plant list for the entire Boston side of the Muddy River and Olmsted Park have been identified and brought together for the first time during the present project. They indicate plant materials not used on the Brookline side that were supplements to those lists. They also indicate the particular conditions of soil, sun and shade under which different groups were to be used. The Boston-side plans are less detailed than those for Brookline, since Olmsted and his firm usually preferred to make many planting decisions in the field as the process continued. William L. Fisher

supervised the planting on the Boston side for the Olmsted firm. He preferred to locate plants in the field rather than do detailed planting plans (see Figure 2.17).

Figure 2.17
Riverway, Topographic Plan for Planting Study, 1893



Source: FLONHS

2.4.1 Historic Resources - Back Bay Yard

Olmsted designed the Back Bay Yard as a scenic picturesque park, with activities that were compatible with enjoying the scenery. As with the Back Bay Fens, Olmsted constructed a circular system along the Muddy River as a part of transformation of the site to serve the purpose of a public park. The path systems and the separation of carriage, horse, and foot traffic were the major features that allowed three categories of users to enjoy scenery without causing physical danger or interfering with the experience of the landscape of each. Olmsted also intended to have the river accessible to canoes. Photographic records show a canoe landing at a gatehouse near Brookline Avenue. The design included nine bridges that interfaced with the river and either provided viewing points or were features of picturesque views. Several of the bridges and culverts were built under a cooperative arrangement between the city and town. The bridges included:

- ♦ the Audubon Bridal Bridge, which provided for foot, street traffic and horseback riding;
- ♦ the Carlton Street Bridge over the railroad tracks provided for foot traffic;

- ♦ the Chapel Station Bridge, a footbridge over the river;
- ♦ the Bridal Path Bridge, a combined footbridge with an equestrian underpass for the bridal path;
- ♦ the Longwood Bridge, accommodating street traffic and including a stair connection from the Brookline side to the park below;
- ♦ the Bellevue Street (Netherlands Road) Bridge for street traffic;
- ♦ two footbridges in the island area between Netherlands Road and Brookline Avenue; and
- ♦ the Bridge at Brookline Avenue in Brookline for vehicles that also serves as a culvert.

Olmsted also introduced three structures to the design: a round stone shelter above the Bridal Path Bridge, an Administration Building near the Audubon Bridge for Boston, and a Gatehouse at Brookline Avenue in Boston to divert Muddy River overflow to the Charles River. The gatehouse and associated conduit were completed in 1883.

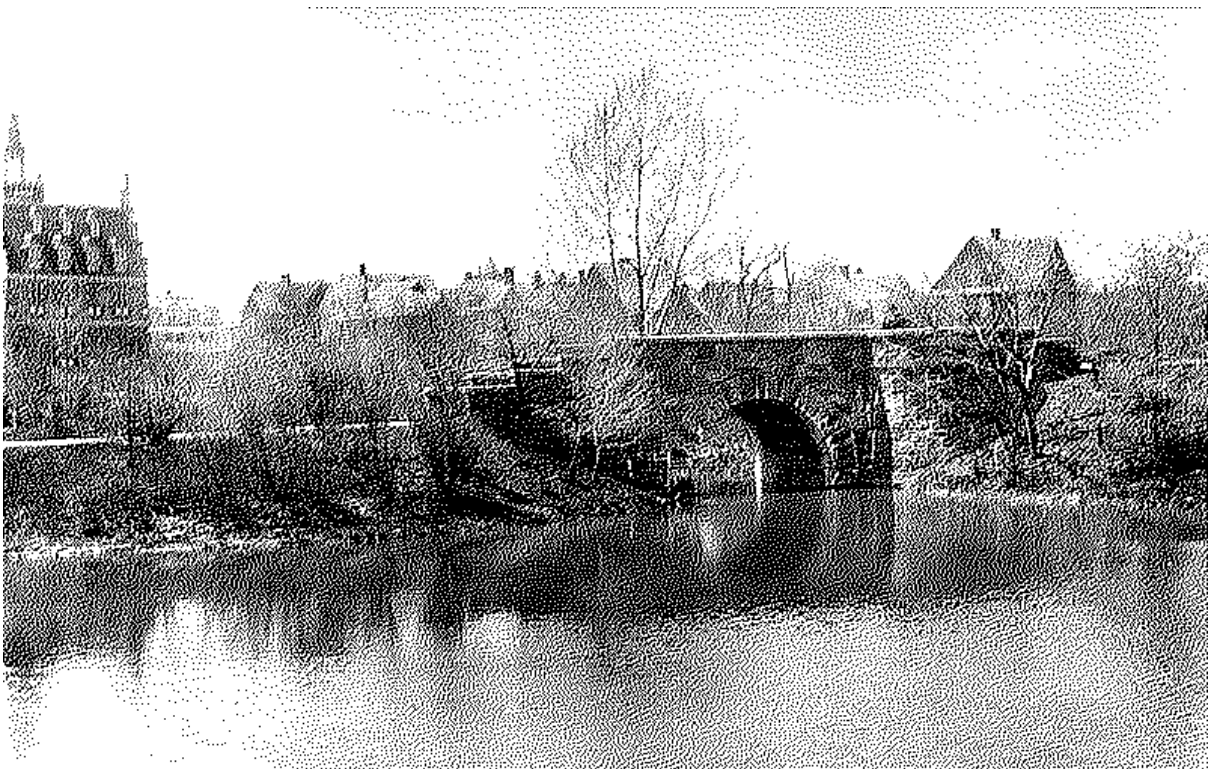


Figure 2.18
Riverway Footbridge near Brookline Avenue at Netherlands Road, 1920

Source: FLONHS

There is no Secondary Period of Significance since there has been no major designer involved in the Riverway since Frederick Law Olmsted's involvement, although the Olmsted Firm did some consulting afterwards. In 1897 John A. Pettigrew was hired as Park Superintendent for the Boston side, following which the contract with the Olmsted Firm was not renewed.

Cynthia Zaitzevsky, in her book, Frederick Law Olmsted and the Boston Park System, states that between 1895 and 1930, the Riverway escaped the massive redesigns of the Back Bay Fens and the removal of original design elements that occurred in the upper part of Olmsted Park to the south. Although modifications occurred, they were generally limited to alterations in plantings. The Riverway, unlike the Fens and Olmsted Park, was not suited to active recreation and organized sports due to its narrowness and terrain, and thus was insulated from these intrusions.

The parkways were not insulated from such intrusions. In the 1930s parkland takings began when the Tremont Street (Route 9) overpass was constructed, impacting the southern end of the Muddy River and its connection to Olmsted Park. From 1934-1949, proposals to construct a rotary at the intersection of Audubon Road (Park Drive) and the northern end of the Riverway were initiated. From 1951-1955 proposals for a by-pass road at the Riverway and Audubon Road were considered. Between 1953 and 1959 parkland was taken for road widening, right-hand turn only lanes, exit and entry ramps, and parking.

During this time commuter traffic continually increased, isolating the Riverway park within a major roadway system. This resulted in the gatehouse, Audubon Bridal Bridge and headwalls at Brookline Avenue being demolished. The Muddy River was filled and culverted, and the parkways around the park were widened and reconfigured. In 1958-1959 the taking of land above the Fens at Brookline Avenue resulted in relocation of the boat launch and filling to construct the Sears Roebuck Company parking lot.

These actions severed the Riverway park from the Fens, negatively impacting pedestrian movement, the equestrian ride, and the canoeing activity in the Riverway park. The equestrian system was impacted so dramatically by the roadway widening and right hand turn only lanes at Longwood Bridge and Brookline Avenue that it was virtually eliminated.

In 1956 the MDC assumed care and control of the Riverway parkway, including a twenty-five (25') foot taking of a right of way into the parkland. Although originally built as a sanitary improvement, the Riverway waterway and park has, overtime, been impacted by the associated drainage and sewerage systems. In addition, the banks are undermined and plantings that originally stabilized the banks, including wetland bank, upland, and canopy plantings are non existent, having been replaced by volunteer tree and shrub growth and extensive invasive herbaceous species. Cynthia Zaitzevsky noted in her report, Riverway Historic Landscape Report, January 1987, that on October 6, 1962, floodwater was discharged through the MBTA tunnels via the new Fenway Park opening and that between 1963 and 1964 two flood control projects were undertaken by the MDC. The projects included dredging the Muddy River from the southerly end of Leverett Pond to Park Drive and installing new culverts as well as constructing a new dike system. In 1971 the Riverway was placed on the National Register of Historic Places under the National Preservation Act of 1966, along with all of Olmsted's Emerald Necklace Parks and Parkway. On October 24, 1989, The Riverway was designated a landmark by the City of Boston, under Chapter 772 of the Acts of 1975.

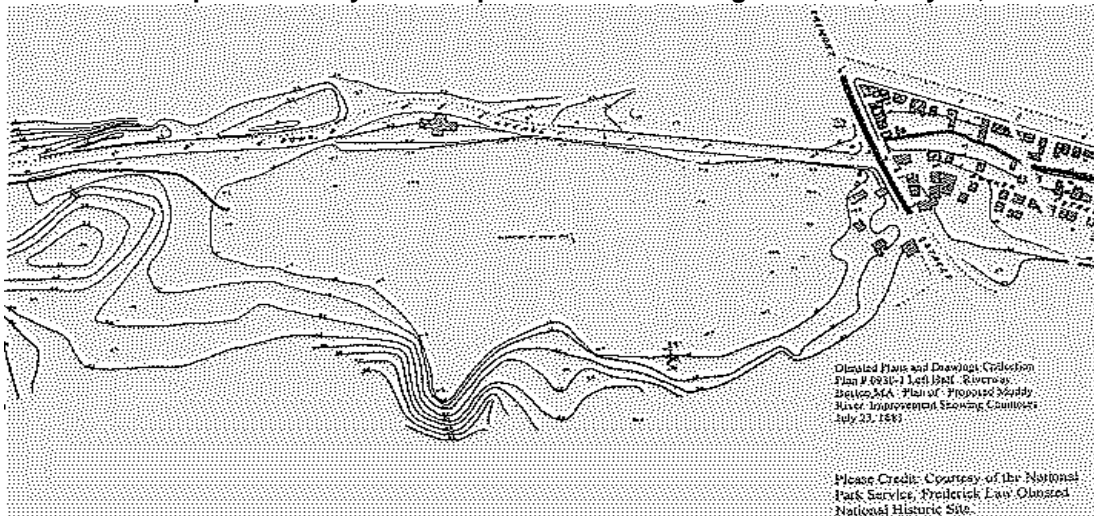
2.5 Historic Resources – Sector IVA, IVB – Olmsted Park

The Leverett Pond area has a Primary Period of Significance, (1880-1895), which is the Frederick Law Olmsted design period for the area between Tremont Street (Route 9) in Brookline and Willow Pond Road. In 1880 Olmsted completed the plan for a "Suggestion for the Improvement of Muddy River", which is published in the Sixth Annual Report of the Boston Park Commissioners and in the Annual Report of the Brookline Park Commissioners. The suggested improvement included a diagrammatic plan for the proposed park prior to the 1881 design plan. Frederick Law Olmsted set forth his intent:

"Upper Valley of Muddy River -- A chain of picturesque fresh-water ponds, alternating with attractive natural groves and meads. From Tremont Street, south to Jamaica Pond, the waters widen out into pools and ponds, connected by a rapid brook, and, besides the scenery a more varied Parkway, the road on the Boston side has been named Jamaica-way, thus indirectly, by change of name, recognizing the change of landscape character. The public way on the Brookline side is named Brookline Road, the use of the word 'road' being appropriate to its rural character." (Note: Tremont Street now Huntington Avenue)

A July 23, 1881 survey titled "Plan of Proposed Muddy River Improvement Showing Contours," prepared by Boston City Engineer Henry M. Wrightman, documents the site prior to the implementation of Olmsted's plan. The Leverett Pond site was an existing fresh-water pond that was modified by Olmsted's design. The creation of the park required change to the boundary between Boston and Brookline (see Figure 2-19).

Figure 2.19
Plan of Proposed Muddy River Improvements Showing Contours, July 23, 1881



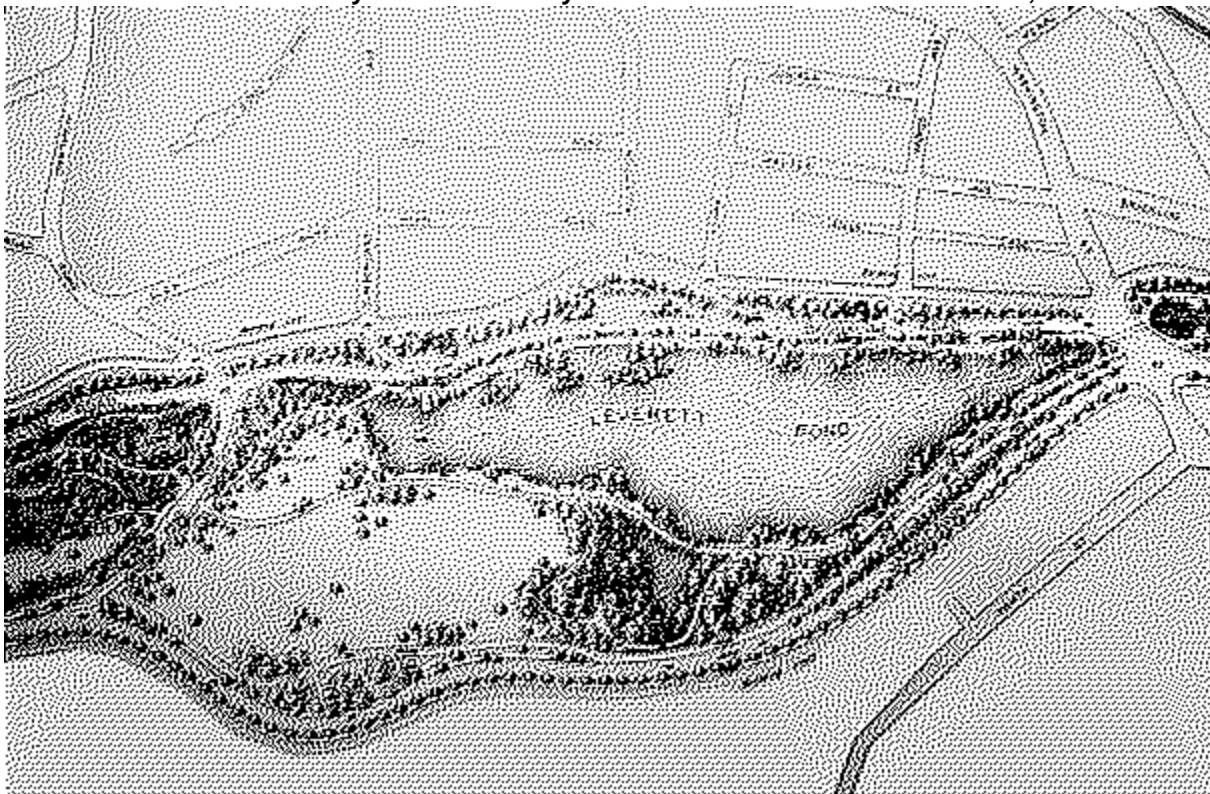
Source: FLONHS

The following decade involved the preparation of several planning efforts including:

- ♦ The 1881 "General Plan for the Sanitary Improvement of Muddy River and for Completing a Continuous Promenade between Boston Common and Jamaica Pond";
- ♦ The 1889 "Outline of Revised Plan for The Parkway and Sanitary Improvement of Muddy River showing the proposed change in the Town boundary and the relationship of the proposed pleasure ground to the neighboring streets and to the suggested revisions to the railroad arrangements between Chapel and Longwood Stations";
- ♦ The 1890 plan published in the Fifteenth Annual Report of the Boston Park Commissioners and the Annual Report of the Brookline Park Commissioners,
- ♦ The 1892 lithograph titled "Plan of the Parkway between Muddy River Gate House and Jamaica Park", which increased the site acreage to accommodate a meadow, now Daisy Field; and
- ♦ The 1896 "Plan of Portion of Park System from Common to Franklin Park" documents the park during the Olmsted Period.

A series of plans dated between 1890 and 1893 provide detailed proposed grading, historic shoreline, plant massings with viewsheds, plant lists, and planting plans for the Olmsted design (see Figure 2.20).

Figure 2.20
Plan of the Parkway Between Muddy River Gatehouse and Jamaica Park, 1892



Source: FLONHS

There is limited photographic documentation for the pond. Photographs illustrate how the shoreline of the pond was constructed and the plantings and the original bank treatments; be they planted or turf covered banks coming down to the edge of emergent vegetation. The Olmsted plans and photographs also show the "Olmsted beaches", which were widened paths that allowed access to the water edge and were made of the same material as the path (see Figure 2-21). In Olmsted's period these were gravel paths. The elevation of the water in Leverett Pond is about three feet lower than the elevation shown on Olmsted's grading plans. This has resulted overtime in the change from the banks of the original beaches to turf covered banks that extend to the waters edge, since the banks today are too steep to negotiate and stabilize as gravel material. The pond on the Brookline side has a gabion treatment to stabilize the edge, which has resulted in herbaceous plants and shrub and tree seedlings invading the edge, some of which are invasive species. The Boston side has a natural shoreline edge.

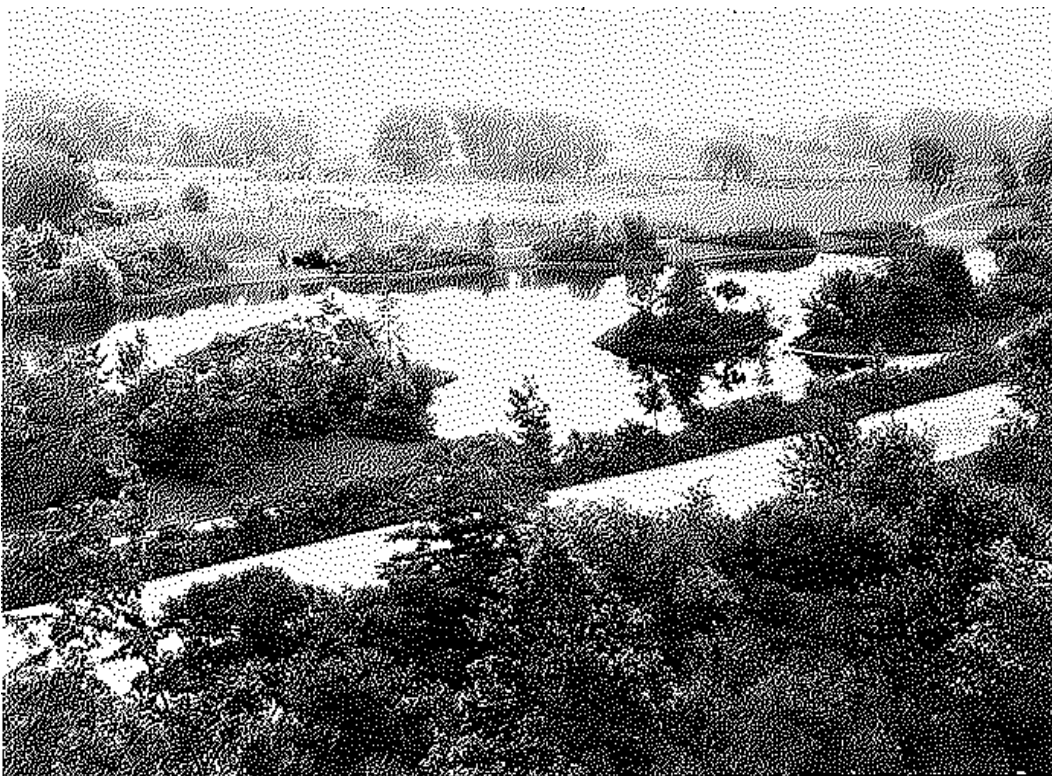


Figure 2.21
View Over Leverett Pond from Allerton Street Overlook, c. 1900

Source: Brookline Public Library

Complete grading plans exist that delineate the grading and layout of the original shoreline as designed and constructed by Olmsted and his firm in the early 1890's. Overlaying the plans for the shoreline created during the Primary Period of Significance with surveys showing the existing conditions demonstrates the shoreline that are extant from that period. Also available are extensive drawings documenting the planting done in Olmsted's time. These include plans showing the intended massing of plant materials and the site direction of dozens of vistas through and over vegetation, providing views up, down and across the river. For Brookline's side there are also detailed plant placement

plans supplemented by extensive planting lists that identify individual trees and plants or groups of plants to be placed in precisely indicated areas. No other park designed by the Olmsted firm during Olmsted's career and with his active participation has nearly as detailed a record of involvement by John C. Olmsted, who carried on the firm's work in the Boston parks after Olmsted's retirement in 1885, and by Warren Manning, the firm's chief plantsman, who had a notable landscape design career of his own beginning in the late 1890's.

Olmsted designed the park as a scenic picturesque park, with activities that were compatible with enjoying the scenery. As with the Back Bay Fens and the Riverway, Olmsted constructed a circulation system around Leverett Pond as a part of his transformation of the site to serve the purposes of a public park. The path systems and the separation of carriage, equestrian and foot traffic were major features that allowed the three categories of users to enjoy the picturesque pond landscape, without causing physical danger or interfering with the experience of the landscape of each. Olmsted also intended to have the pond accessible to canoes. A canoe landing with boathouses was studied for Leverett Pond and a temporary landing was built in 1895, probably at the southern end.

The Cumberland Avenue Bridge was built at the southern end of the pond to cross over the brook feeding into the pond. A second bridge was constructed at the northeast edge to form the cove that today is called the Cove Bridge. Both bridges were stone masonry bridges and allowed for movement through a constantly changing "passage of scenery". It should be noted that as the water level in the pond went down, the cove created by Olmsted was no longer feasible and it was filled. The bridge still remains today (see Figure 2.22).



Figure 2.22
View of Leverett Pond Cove Bridge, c. 1900
Source: Frances Loeb Library HASD

There is no Secondary Period of Significance since there has been no major designer involved in Olmsted Park since Frederick Law Olmsted's involvement. In 1897, John A. Pettigrew was hired as Park Superintendent for the Boston side. The contract with the Olmsted Firm was not renewed. In 1898 the first dredging in Leverett Pond at the mouth of the Village Brook storm sewer occurred.

In the 1940's the Boston Park Department placed a baseball diamond in the meadow east of Leverett Pond. Today this meadow is called Daisy Field. A second baseball diamond followed, as did associated lighting. In 1956 the Metropolitan District Commission assumed care and control of the Jamaicaway, Perkins Street, Chestnut Street and Willow Pond Road as well as a twenty-five (25') foot taking of a right of way into the parkland. Pond Avenue, which is dated to the 1881 survey, is the only road surrounding the park that is not under MDC control.

In 1971 Olmsted Park was placed on the National Register of Historic Places under the National Preservation Act of 1966, along with all of Olmsted's Emerald Necklace Parks and Parkways. In October 24, 1989 Olmsted Park was designated a landmark by the City of Boston under Chapter 772 of the Acts of 1975.

Projects completed in Olmsted Park since the adoption of the Emerald Necklace Master Plan are documented in the Master Plan.

2.6 Historic Resources – Sector IVB - Willow Pond

The Willow Pond Area has a Primary Period of Significance of 1880-1895, which is the Frederick Law Olmsted design period for the area. In 1880 Olmsted completed a plan titled "Suggestion for the Improvement of Muddy River", which is published in the Sixth Annual Report of the Boston Park Commissioners and in the Annual Report of the Brookline Park Commissioners. The suggested improvement included a diagrammatic plan for the proposed park prior to the 1881 design plan. Frederick Law Olmsted set forth his intent:

"Upper Valley of Muddy River -- A chain of picturesque fresh-water ponds, alternating with attractive natural groves and meads. From Tremont Street, southwardly to Jamaica Pond, the waters widen out into pools and ponds, connected by a rapid brook, and, besides the scenery a more varied Parkway, the road on the Boston side has been named Jamaica-way, thus indirectly, by change of name, recognizing the change of landscape character. The public way on the Brookline side is named Brookline Road, the use of the word 'road' being appropriate to its rural character."

A July 23, 1881 survey titled "Plan of Proposed Muddy River Improvement Showing Contours," prepared by Boston City Engineer Henry M. Wrightman, documents the site prior to the start of Olmsted's work. The Willow Pond site was a small pond with a small brook feeding it and a small brook out-letting to Leverett Pond (see Figure 2.23).



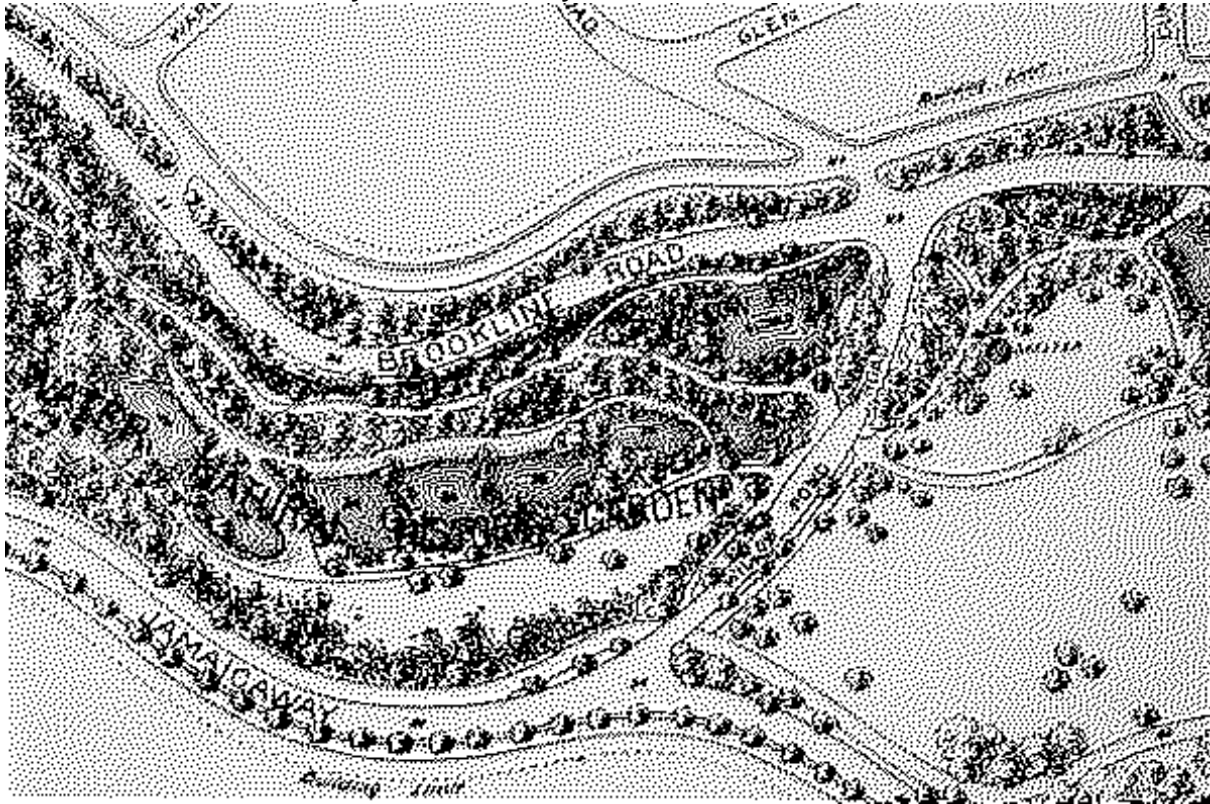
Figure 2.23
Plan of Proposed Muddy River Improvements Showing Contours 1881

Source: FLOHNS

Several sources of information document the park during the Olmsted period including:

- 1) The 1881 "General Plan for The Sanitary Improvement of Muddy River and for Completing a Continuous Promenade between Boston Common and Jamaica Pond";
- 2) The 1889 "Outline of Revised Plan for The Parkway and Sanitary Improvement of Muddy River showing the proposed change in the Town boundary and the relationship of the proposed pleasure ground to the neighboring streets and to the lately suggested revisions to the railroad arrangements between Chapel and Longwood Stations;
- 3) "The 1889 Revised plan for the upper part of the Muddy River (Olmsted Park), increases the site acreage to accommodate the natural history pools);
- 4) The 1890 plan published in the Fifteenth Annual Report of the Boston Park Commissioners and the Annual Report of the Brookline Park Commissioners;
- 5) The 1892 lithograph titled "Plan of the Parkway between Muddy River Gate House and Jamaica Park (see Figure 2-24), and 6) the 1896 "Plan of Portion of Park System from Common to Franklin Park document the park during the Olmsted Period.

Figure 2.24
Plan of the Parkway Between Muddy River Gatehouse and Jamaica Park, 1892



Source: FLONHS

In addition, a series of plans dating 1890 to 1893 provides detailed proposed grading, historic shoreline, plant massings with viewsheds, plant lists, and planting plans for the Olmsted design.

There is limited photographic documentation for the pond. Photographs illustrate the construction of the pond shoreline, the plantings and original bank treatments; be they planted or grass beaches coming down to the edge of emergent vegetation (see Figure 2.25).



Figure 2.25
View of Willow Pond Toward Willow Pond
Road Culvert Bridge, 1900

Source: FLOHNS

Complete grading plans delineating the grading and shape of the shoreline as designed and constructed by Olmsted are available. By overlaying the plans of the shoreline created during the Primary Period of Significance with surveys showing the existing conditions today, it can be determined which shoreline areas are extant from that period. Extensive drawings documenting the planting that was done in Olmsted's circulation system around Willow Pond as part of his transformation of the site to serve the purposes of a public park are also available. The path systems and the separation of carriage and foot traffic were the major feature that allowed the passive user to view the picturesque pond landscape and the carriage drive or parkway to view its green edge, without causing physical danger or interfering with the experience of the landscape of each. Riverdale Parkway, west of Willow Pond was designed and constructed by Olmsted as a park drive within the park, but it had become a commuter route with parked cars at its edge and was impacting the use of the park. The 1990 Master Plan discontinued the parkway

converting it into a pedestrian and bicycle path, which was completed between 1998 and 2000.

A granite footbridge was built at the southern end of the pond to cross over the Babbling Brook feeding into the pond. Willow Pond Bridge, a bridge/culvert, was constructed at the north edge as the water left the pond. Both bridges provided viewing points or were features set in Olmsted's picturesque views. Two small stone culvert bridges were constructed in the history pool area and a bridge/culvert and waterfall entered the east side of Willow Pond below the history pools.

There is no Secondary Period of Significance since there has been no major designer involved in Olmsted Park since Frederick Law Olmsted's involvement. In 1897 John A. Pettigrew was hired, as Park Superintendent for the Boston side and the contract with the Olmsted Firm was not renewed. A decision was made under Pettigrew to fill two of the Natural History pools at Spring Pond above Willow Pond (1898), since the Society could not raise funds. Pettigrew also began "rearranging" the plantations, adding broadleaf evergreens.

State legislation in 1962 and 1963 directed the MDC to take by eminent domain or otherwise, land in Jamaica Plain and elsewhere for skating rinks. In 1964 the City of Boston conveyed to the MDC a parcel of land east of Willow Pond to construct a skating rink. By 1965 the Sergeant Peter Kelly Rink was constructed. In 1997 the rink was removed.

Further takings as well as modifications to the parkway and road systems were planned by the MDC starting in 1967, when a one-way system of parkways was recommended around Olmsted Park and Jamaica Pond. This involved a taking by eminent domain by the MDC of Riverdale Parkway. Brookline fought this in the courts up to the state Supreme Court and won, so the parkways were not widened or made one-way and the parkway remained under town ownership.

In 1971 Olmsted Park was placed on the National Register of Historic Places along with all of Olmsted's Emerald Necklace Parks. In 1982 Brookline installed a gabion system on the west shore of the pond. In 1983, Olmsted Park was designated a landmark by the City of Boston.

2.7 Historic Resources – Sector IVB – Ward's Pond

The Ward's Pond Area has a Primary Period of Significance, 1880 to 1895, which is the Frederick Law Olmsted design period for the area. In 1880, Olmsted completed a plan for a "Suggestion for the Improvement of Muddy River", which was published in the Sixth Annual Report of the Boston Park Commissioners and in the Annual Report of the Brookline Park Commissioners. The suggested improvement included a diagrammatic plan for the proposed park prior to the 1881 design plan. Frederick Law Olmsted set forth his intent:

"Upper Valley of Muddy River -- A chain of picturesque fresh-water ponds, alternating with attractive natural groves and meads. From Tremont Street, southerly to Jamaica Pond, the waters widen out into pools and ponds, connected by a rapid brook. The road on the Boston side has been named Jamaica-way, thus, by change of name, recognizing the change of landscape character. The public way on the Brookline side is named Brookline Road, the use of the word 'road' being appropriate to its rural character."

A July 23, 1881 survey titled "Plan of Proposed Muddy River Improvement Showing Contours," prepared by Boston City Engineer Henry M. Wrightman, documented the site prior to the start of Olmsted's work. The Wards Pond site was an existing pond (see Figure 2.26).

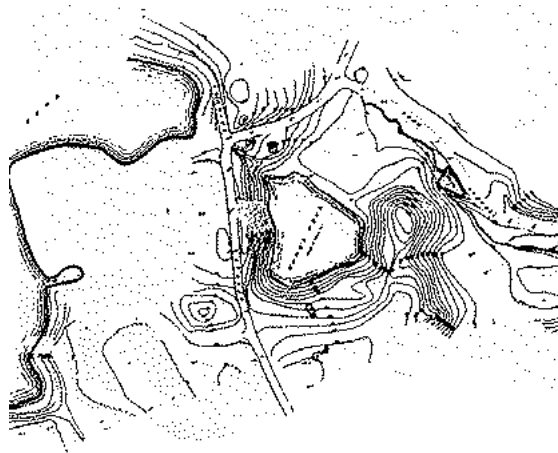


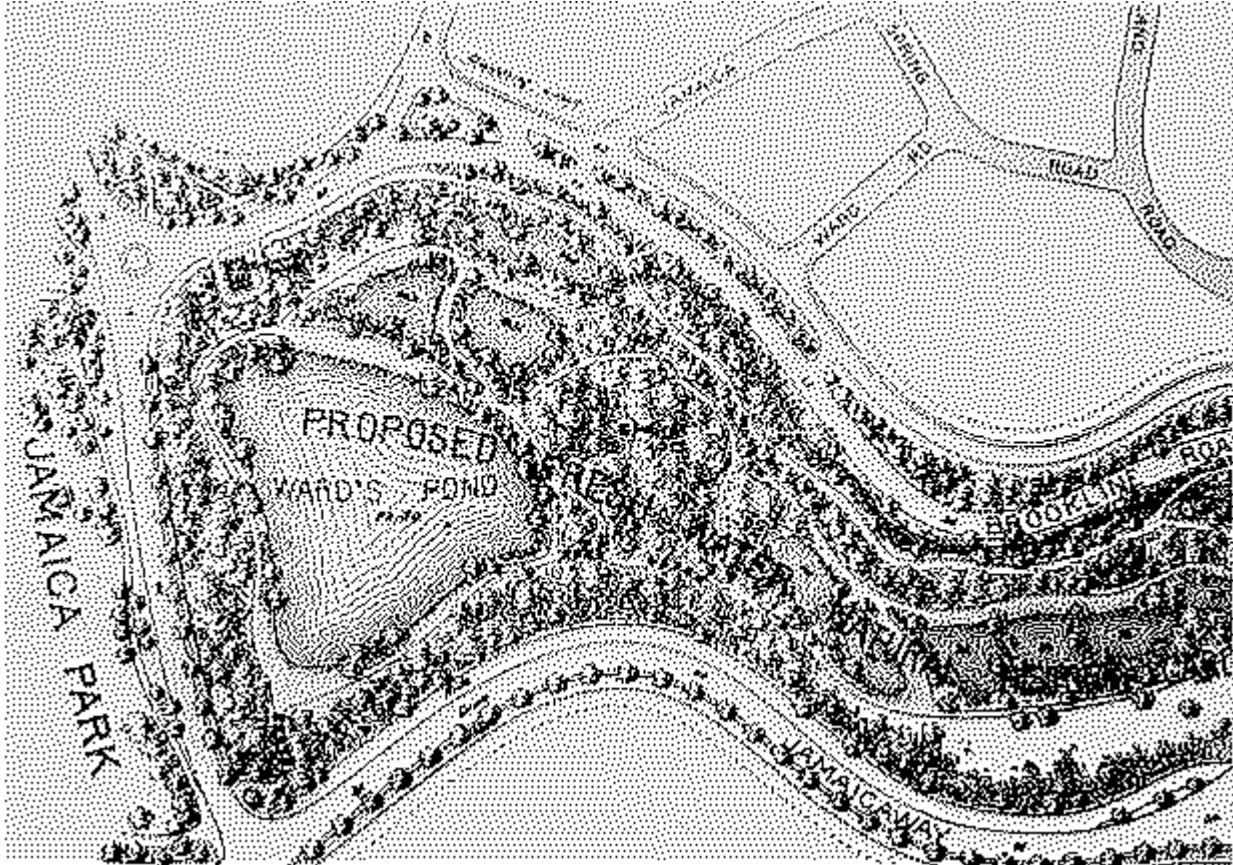
Figure 2.26
Plan for Proposed Muddy River Improvements Showing Contours, 1881
Source: FLONHS

The following resources document the park during the Olmsted Period:

- 1) The 1881 "General Plan for The Sanitary Improvement of Muddy River and for Completing a Continuous Promenade between Boston Common and Jamaica Pond";
- 2) The 1889 "Outline of Revised Plan for The Parkway and Sanitary Improvement of Muddy River showing the proposed change in the Town boundary and the relationship of the proposed pleasure ground to the neighboring streets and to the lately suggested revisions to the railroad arrangements between Chapel and Longwood Stations";
- 3) The 1890 plan published in the Fifteenth Annual Report of the Boston Park Commissioners and the Annual Report of the Brookline Park Commissioners;
- 4) The 1892 lithograph titled "Plan of the Parkway between Muddy River Gate House and Jamaica Park; and
- 5) The 1896 "Plan of Portion of Park System from Common to Franklin Park document the park during the Olmsted Period.

In addition, a series of plans dating from 1890 to 1893 provide detailed proposed grading, historic shoreline, plant massings with viewsheds, plant lists, and planting plans for the Olmsted design (see Figure 2.27).

Figure 2.27
Plan of the Parkway Between Muddy River Gate House and Jamaica Park, 1892



Source: FLONHS

Extensive photographic documentation for the pond exists particularly in the early 1900's. These photographs illustrate the shoreline of the pond, the plantings, and original bank treatments, either planted or grass beaches coming down to the edge of emergent vegetation (see Figure 2.28).

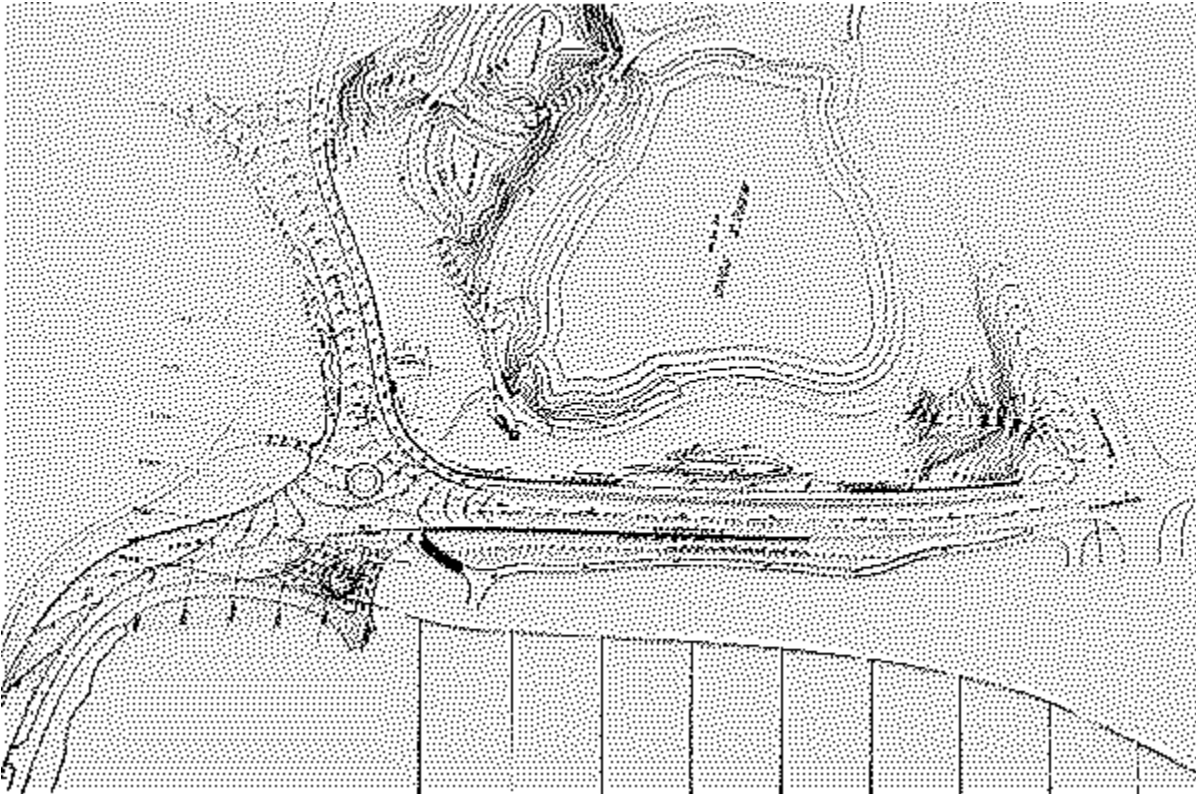


Figure 2.28
View of Wards Pond Looking Towards Perkins Street, 1904

Source: FLONHS

Complete grading plans exist that delineate the grading and shape of the original shoreline as designed and constructed by Olmsted and his firm in the early 1890's. The plans can be overlayed to the shoreline created during the Primary Period of Significance with surveys showing the existing conditions today, and so determine what areas of shoreline are extant from that period. Also available are extensive drawings documenting the planting that was done in Olmsted's time. These include plans showing the intended massing of plant materials and the site direction of dozens of vistas through and over vegetation, providing views across the pond. Planting plans supplemented by extensive planting lists identify individual trees and plants or groups of plants to be placed in precisely indicated areas. No other park designed by the Olmsted firm during Olmsted's career and with his active participation has nearly as detailed a record of involvement by John C. Olmsted, who carried on the firm's work in the Boston parks after Olmsted's retirement in 1885, and by Warren Manning, the firm's chief plantsman, who had a notable landscape design career of his own beginning in the late 1890's (see Figure 2.29).

Figure 2.29
Grading Plan at Ward's Pond, 1900



Source: FLONHS

The planting plans and plant list for the entire Boston side of Olmsted Park have been identified and brought together for the first time during the present project. They indicate plant materials not used on the Brookline side that were to supplement those lists. They also indicate the particular conditions of soil and sunshade under which different groups of plants were to be used. The Ward's Pond plans are plant massings, since Olmsted and his firm usually preferred to make planting decisions in the field.

Olmsted designed the park as a picturesque park with activities that were compatible with enjoying the scenery. As with the Back Bay Fens and the Riverway, Olmsted constructed a circulation system around Ward's Pond. The path systems and the separation of carriage and foot traffic were the major feature that allowed the passive user to view the picturesque pond landscape and the carriage drive or parkway to view its green edge without causing physical danger or interfering with the experience of the landscape of each. The path system around the pond was complete in 1895, except for the northern side.

Two boulder/culvert bridges were constructed at the north and south ends of the pond. Both bridges provided viewing points or were features set in Olmsted's picturesque views. The area of the history pools west of the pond had two boulder/culvert bridges, which were demolished along with the history pools by John A. Pettigrew in 1897. A granite footbridge spans the babbling brook at the Ward's Pond exit.

There is no Secondary Period of Significance since there has been no major designer involved in Olmsted Park since Frederick Law Olmsted's involvement, although the Olmsted Firm did some consulting afterwards. In 1897 John A. Pettigrew was hired, as Park Superintendent for the Boston side and the contract with the Olmsted Firm was not renewed. The decision was made by Pettigrew to fill two of the Natural History pools at Spring Pond (1898), since the Society could not raise funds. By 1899, additional pools were filled, and the boulder bridges were demolished at Wards Pond. Pettigrew also began "rearranging" the plantations, adding broadleaf evergreens with particularly dense plantings on the east and south banks of Wards Pond (see Figure 2.30).

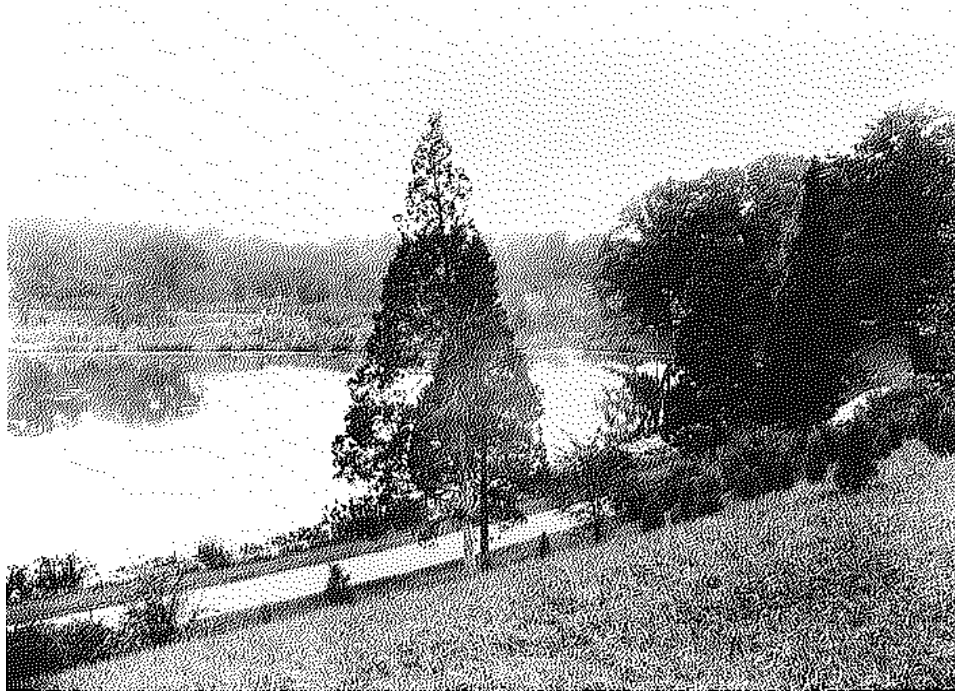


Figure 2.30

Wards Pond from Near Jamaicaaway Looking North Towards Chestnut Street, c. 1900

Source: FLONHS

In 1971 Olmsted Park was placed on the National Register of Historic Places under the National Preservation Act of 1966 along with all of Olmsted's Emerald Necklace Parks. On October 24, 1989, Olmsted Park was designated a landmark by the City of Boston under Chapter 772 of the acts of 1975.

CHAPTER 3: EXISTING CONDITIONS

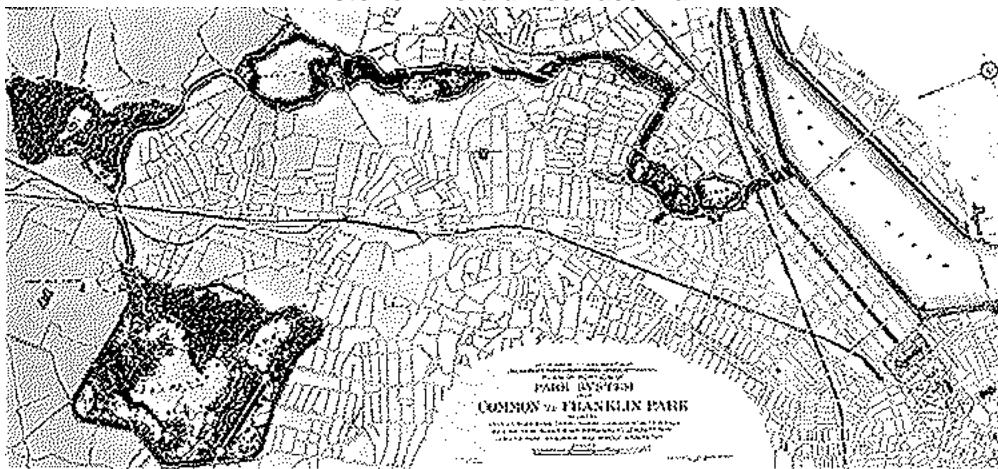
Before management and maintenance recommendations can be made, a thorough inventory of the existing conditions and park operations must be documented. The following narrative documents these components of the park, as they existed in 2001. This chapter contains descriptions of the landscape elements, unique resources and existing park uses in each of the parks included in the Muddy River Restoration Project Phase I. The analysis of existing conditions is organized by park: Charlesgate, Back Bay Fens, Riverway, Leverett Pond, Willow Pond, and Ward's Pond, and by maintenance sector: Sector I – Charlesgate, Sector II A - Back Bay Fens North: Victory Garden's/Mother's Rest; Sector II B – Back Bay Fens Central: Rose Garden/Clemente Field; Sector II C – Back Bay Fens and Sears Parking Lot; Sector III – Riverway; Sector IV A – Olmsted Park North: Leverett Pond/Daisy Pond; Sector IV B – Olmsted Park South: Ward's Pond/Willow Pond/Nickerson Hill.

3.1 Introduction

The Muddy River watershed is located within the City of Boston and the Town of Brookline, Massachusetts. A small part of the watershed is located in Newton.

The Muddy River Project area is contained within the historic park system that is known as the Emerald Necklace. The Emerald Necklace consists of a series of six parks that was planned by Frederick Law Olmsted to extend from the Boston Public Garden and along Commonwealth Avenue, encompassing the Muddy River through the Arnold Arboretum and Franklin Park to the South Boston beaches, and culminating at Castle Island. The link from Franklin Park through Dorchester was never constructed. A circa 1897 plan (see Figure 3.1) depicts the layout of the present-day Emerald Necklace and encompasses the following park areas: Charlesgate, Back Bay Fens, Riverway, Olmsted Park (Leverett Pond, Willow Pond, Ward's Pond, Jamaica Pond), the Arnold Arboretum and Franklin Park.

Figure 3.1
Historic Emerald Necklace Plan



Source: FLONHS

The Emerald Necklace and its adjacent parkways are listed on the National Register of Historic Places and located near several other districts, individual structures, and institutions that are also listed on the National Register in addition to being designated as landmarks by the Boston Landmarks Commission.

3.2 Existing Conditions - Charlesgate Area (Sector I)

The Charlesgate area of the Muddy River includes the parkland that extends linearly from Ipswich Street to the Charles River (Figure 3.2). The Charlesgate area contains several main roadways including the elevated Bowker interchange, Commonwealth Avenue, Beacon Street, Boylston Street and several local streets with connections to Storrow Drive. The Massachusetts Turnpike and the CSX railroad (Boston and Albany line) also bridge the Muddy River.

The land use in the Charlesgate area is both commercial and residential with a substantial number of student apartments. Kenmore Square and Fenway Park (the Boston Red Sox) are nearby, as are a number of colleges and universities (Boston University, Berkeley College of Music). The Massachusetts Bay Transportation Authority (MBTA) provides mass-transit via bus, subway and rail service.

The Charlesgate area is the furthest downstream segment of the Muddy River before it flows through large conduits under Storrow Drive and into the Charles River. The Muddy River channel in this area consists entirely of rock and concrete construction with no wetland vegetation present. Scattered stands of Japanese knotweed have been observed in this area. The surrounding landscape of the river is either grass or bare ground with some trees and shrubs.

Figure 3.2 Charlesgate Area



The Charlesgate area is a maintained urban park with extensive lawns, some mature trees, and few shrubs. *Phragmites australis* (phragmites) does not grow in this area.

The inventory, documentation, and analysis of vegetation in the Charlesgate area were completed in August of 2000. The area includes the watercourse from the Charles River to the Boylston Street Bridge (Richardson Bridge). The scope of work included

documentation of trees, shrubs, vines, and lawn areas including notation of areas with bare lawn and erosion (Table 3.1).

Table 3.1 Inventory and Analysis of Existing Vegetation – Charlesgate

Category	Unit	Total	Good	Fair	Poor	Dead
Trees:						
Canopy tree	each	233	87	132	12	7
Flowering tree	each	17	0	13	1	0
Evergreen tree	each	40	16	19	0	0
Heritage tree ¹	each	11	5	2	1	0
Total Trees:		301	108	166	14	7
Shrubs:						
	(Estimated)					
Restored planting	square footage	0				
Shrub massing	square footage	1,890				
Total Shrubs:		1,890				
Invasive Plant Colonies:						
	(Estimated)					
Flax grasses	square footage	12,509				
Other Invasives (= ex. Knotweed)	square footage	9,415				
Total Invasive Plant Colonies:		21,924				
Wetland:						
	(Estimated)					
	square footage	0				

¹Note: A heritage tree is a canopy tree with a 12" or greater caliper. If it is listed as a heritage tree, it will not be listed as a canopy tree.

In accordance with the Commonwealth of Massachusetts Department of Environmental Management standards, trees that are 32" inches in caliper and over are considered to be heritage trees. All trees have their species and caliper size identified and the condition of the heritage trees is rated as good, fair or poor as are all other trees on the site. The diameter of the circle for tree canopy is in relation to its caliper size.

The wildlife resources of the Charlesgate area include avian and non-avian species. The Charlesgate area does not contain wetland vegetation or any natural environmental amenities. Therefore, the Project's Wildlife Habitat Evaluation and Vegetation Assessment did not extend to this area.

Passive recreation in the Charlesgate area is limited to a series of poorly lit seating areas. There is no active recreation in this location. Current use of this area is limited due to two factors: the lack of a pedestrian path parallel to the river and to the domination and shading of the space by the Bowker Overpass.

Historic Structures

The one historic structure at Charlesgate is the gatehouse at the Fens outlet to the Charles River. It is beneath the 1960s Storrow Drive/Charlesgate (Bowker) Interchange. Smaller than the Stony Brook Gatehouses, it is more elaborate and monumental. Like the two gatehouses upstream, its equipment is not fully operable. Debris, including floating sludge and grease, is periodically removed by the MDC.

3.3 Existing Conditions - Back Bay Fens (Sectors IIA, IIB and IIC)

The Back Bay Fens consists of linear parkland that extends southerly (upstream) along the Muddy River from Boylston Street at the Richardson Bridge, to the Riverway/Park Drive area, in front of the new Landmark Center (formerly the Sears Building). The Back Bay Fens contains a number of intersecting roadways and is paralleled by the DCR-maintained Park Drive and the Fenway (Parkway). The Back Bay Fens contains the following maintenance sectors: Sector II A – Back Bay Fens North: Victory Gardens/Mother’s Rest, Sector II B – Back Bay Fens Central: Rose Garden/Clemente Field and Sector II C – Back Bay Fens South and Sears Parking Lot.

The Back Bay Fens contains lawn areas, numerous mature shade trees and smaller trees, and shrubs. Many paved and unpaved paths transect the park. The shoreline of the Muddy River along both sides of the Back Bay Fens is earthen, although it is heavily overgrown by extremely dense stands of giant reed grass (*Phragmites australis*) which grow along much of the bank and well out into the waterway, severely restricting its flood flow capacity. This is particularly true in the area of the Back Bay Fens GateHouse, Agassiz Road and the Victory Gardens. While some of the bank is in good condition, other parts of the bank are eroded and/or undercut.

There are abundant cultural and institutional resources, and adjacent to the Back Bay Fens. These include: the Victory Gardens, Mother’s Rest playground, the Boston Emergency Management Agency field office (a former fire station), the Duck House, War Memorial, Rose Garden, and Clemente Field. The Back Bay Fens also contains apartments and longer-term residences, the Museum of Fine Arts, the Museum School, the Gardner Museum, Northeastern University, Wentworth Institute, Berkley College of Music, MIT, Boston Conservatory of Music, Forsyth Dental School, Harvard Medical School, Emerson College, Emmanuel College, and Wheelock College.

The Back Bay Fens contains two sections of river where the original channel has been culverted and filled over. These areas are located under the former Sears parking lot adjacent to the recently opened Landmark Center and abutting roadways, and upstream of the Fens Bridge at Avenue de Louis Pasteur. As the Muddy River flows through the two 6-foot diameter culverts under the former Sears parking lot, it passes through a diversion chamber for the Muddy River Conduit. This conduit, which is located under part of Brookline Avenue, takes higher stormwater flows directly to the Charles River. There is a low flow weir in the Muddy River Conduit, which allows low flow water to continue into the Back Bay Fens. The Back Bay Fens contains a number of small, individual stormwater outfalls from Park Drive and the Fenway. Larger noteworthy outfalls include

the overflow from the Stony Brook Conduit at Boston Gatehouse No. 1 and the Emmanuel College Drain overflow.

Figure 3.3 Back Bay Fens



The Back Bay Fens (Figure 3.3) is a maintained urban park with extensive lawns, mature trees, and some shrubs. Monotypic stands of *Phragmites australis* dominate much of the shoreline of the Fens. The plant grows to heights of 18-20 feet. The *Phragmites australis* extends considerably into the waterway, severely constricting the flow of water and storage capacity. The following sections include information on the existing woodlands, horticultural resources and aquatic and wildlife resources and wetlands along the Back Bay Fens section of the Muddy River.

The inventory, documentation, and analysis of vegetation in the Back Bay Fens Area were completed in August of 2000. The area includes the watercourse from the Boylston Street Bridge (Richardson Bridge) to the Riverway at Sears Parking Lot. The scope of work includes trees, shrubs, vines, and lawn areas including notation of areas of bare lawn and areas of erosion (Table 3.2).

Table 3.2 Inventory and Analysis of Existing Vegetation – Back Bay Fens

Category	Unit	Total	Good	Fair	Poor	Dead
Trees:						
Canopy tree	each	1,223	251	802	165	5
Flowering tree	each	180	17	134	25	4
Evergreen tree	each	12	1	11	0	0
Heritage tree	each	88	21	56	11	0
Total Trees:		1,503	290	1,003	201	9
Shrubs:						
	(Estimated)					
Restored planting	square footage	0				
Shrub massing	square footage	26,666				
Total Shrubs:		26,666				
Invasive Plant Colonies:						
	(Estimated)					
Phragmites	square footage	358,382				
Other Invasives (e.g. Knotweed)	square footage	26,536				
Total Invasive Plant Colonies:		384,918				
Woodland:						
	(Estimated)					
	square footage	0				

¹Note: A heritage tree is a canopy tree with a 32" or greater caliper. If it is listed as a heritage tree, it will not be listed as a canopy tree.

In The Back Bay Fens, there are both organized and informal sports areas. An athletic field that includes a track and field area with bleacher seating was constructed in 1929. In addition, a baseball diamond is now within the track area. Basketball and volleyball courts, added later, are located in an adjacent area. Less organized active recreation areas include paths for activities such as walking, running, and biking and open lawn for informal catch and Frisbee throwing. The Victory Gardens, one of the few gardens established during World War II to still be in active use, provide gardening activity for those who can secure the use of a plot.

There is also passive recreation in the Fens area with numerous benches along the paths, areas of open lawn for informal seating, a rose garden and war memorial area for sitting and viewing. The historical Victory Gardens also provide viewing opportunities.

Historic Structures

The following are referenced in the Emerald Necklace Master Plan as existing historic structures in the Back Bay Fens.

- ♦ Boylston Street Bridge
- ♦ Agassiz Bridge

- Fen Bridge
- Stony Brook Gatehouse
- Fens Gatehouse
- Agassiz Road Shelter (Duck House)
- Clemente Field House
- Boston Fire Alarm Headquarters
- World War II Memorial, Vietnam Memorial, Korean Memorial

The Back Bay Fens has the greatest number of buildings in the Emerald Necklace system. It also boasts three of the most significant original bridges: Boylston Street, Agassiz and Fen. It contains the original Stony Brook Gatehouses, the Fens Gatehouse at Charlesgate, and a number of memorials and monuments.

Although it carries heavy traffic, Boylston Street Bridge has always been well maintained. Only minor repointing and graffiti removal is needed at this time. Agassiz Bridge was restored to eradicate minor cracks, replace capstones and accomplish minor repointing and graffiti removal. The north viewing bay was severely damaged by a car in 1988. Full restoration of the bridge, including understory plantings, was completed in 1988. The south headwall of the Fen Bridge is intact, but many places need mortar fills and the removal of vegetation and graffiti.

Located below the Museum of Fine Arts are two small pedestrian bridges built in 1978. These need minor repainting, pointing and placement paving.

The Agassiz Road Shelter (the Duck House) has been severely fire damaged and some of the roof has caved in. Roberto Clemente Field House has been extensively vandalized and defaced.

The Boston Fire Alarm Headquarters is a massive building with historic masonry walls. With the exclusion of some surface staining these walls are apparently sound. The building's exterior terraces and walls are in poor condition. The Mother's Rest Shelter requires minor upkeep and repainting.

All the memorials and monuments except for the World War II Memorial were in fairly good condition. Most needed minor cleaning and graffiti removal. The World War II Memorial, a major feature, had been vandalized: plaques were missing, stone retaining walls and pavements settled, base pedestals were damaged and seats were in need of repair or replacement. The rehabilitation of the World War II Memorial and the construction of the Korean and Vietnam Memorials was completed in 1990 through a project funded by the Boston White Fund. In contrast, the nearby Rose Garden fountain and monuments have been continually well maintained.

The Stony Brook Gatehouses (Nos. 1 & 2) have granite masonry walls in good condition. These original engineering structures allowed Stony Brook to discharge into the Lower Fens (then a coastal marsh) and enter the tidal Charles River. Gatehouse Number 1 was built in 1905 by H.H. Richardson's successor firm. The design replicated the smaller

1882 Richardson Gatehouse, which was moved to a new foundation over the Stony Brook Conduit in 1905.

Most of the structures in the Fens, both old and new, require extensive repair and rehabilitation. Work on recently vacant buildings, such as the Agassiz Road Shelter and Clemente Field House, as well as work required to repair the drainage control functions at the gatehouses, will require major capital expenditures.

3.4 Existing Conditions - The Riverway (Sector III)

The historic boundary of the Riverway section of the Emerald Necklace was located at Brookline Avenue, before the segment between the Back Bay Yard and Brookline Avenue was filled for construction of the Sears Parking Lot. The Riverway currently begins at the twin 6-foot culverts at Park Drive and the Riverway roadway itself. There are also numerous cultural and institutional resources along the Riverway. These include the members of the Medical Academic and Scientific Community Organization, Inc. (MASCO), Wheelock College, the Winsor School, Simmons College, and numerous apartment and condominium units.

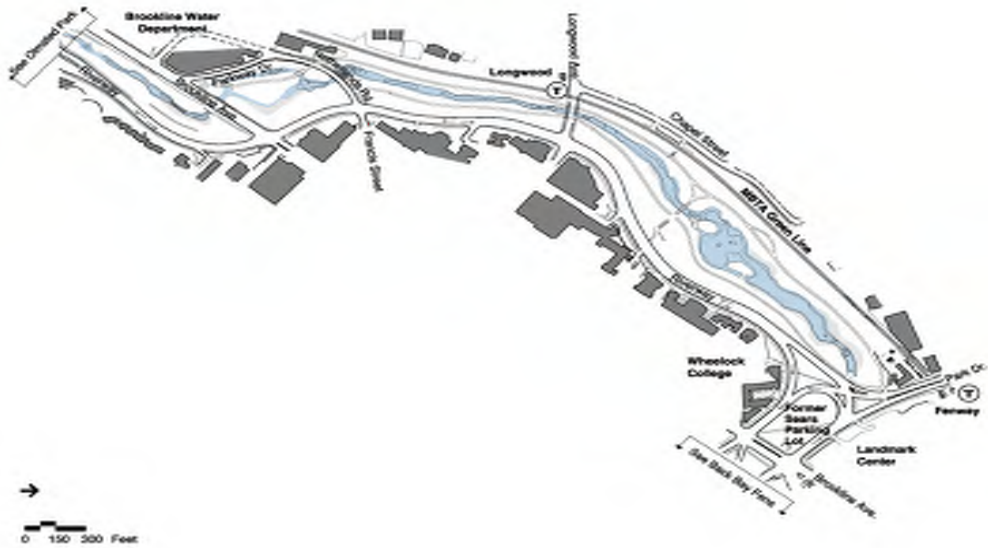
The Muddy River flows north from Leverett Pond into the Riverway. The Riverway comprises a linear park along both sides of the Muddy River. It consists of a maintained grassy parkland with paved and unpaved paths, a mixture of mature Olmsted-planted trees and younger volunteer trees, and some shrubs (Figure 3.4).

The DCR-maintained Riverway parkway runs parallel along the River's east side (Boston) with the MBTA Green Line tracks running along the west side (Brookline) until Netherlands Road where local Brookline streets are encountered. The Riverway (watercourse) is bordered on both sides with linear grassed parkland, and numerous paralleling and intersecting roadways. With the exception of a rip-rapped channel immediately downstream of the Route 9 bridge and the area under Longwood Avenue Bridge, the shoreline of the Muddy River along both sides of the Riverway consists of naturalized terrain designed by Olmsted. Considerable lengths of the bank have no vegetation and need stabilization as they are either eroding and/or being undercut by stormwater runoff and river flow.

The Riverway contains three islands along its length, all designed by Olmsted. The only accessible island is located between Brookline Avenue and Netherlands Road, where formal stairs and bridges provide pedestrian access to the maintained island park. The other two islands are not maintained nor are they accessible. Dense growth of *Phragmites* is present along The Riverway. It has blocked the flow channel at the Island Area and has severely narrowed the flow channel at several other locations, particularly immediately upstream of the two six-foot culverts at the Back Bay Yard.

The Riverway contains a number of stormwater outfalls. Those that are most noteworthy include the Huntington Avenue Drain, which discharges on the Boston side of the Muddy River; and the Tannery Brook and Longwood Avenue Drains, both of which are located in Brookline.

Figure 3.4 The Riverway



The environment surrounding The Riverway consists of a maintained urban park with mature trees, grass and some shrubs. *Phragmites* and Japanese knotweed are dominant in a number of locations and the habitat diversity along the Riverway is not as desirable as it is in Olmsted Park. The following sections include information on the existing woodlands, horticultural, aquatic, wildlife resources, and wetlands along the Riverway section of the Muddy River.

The inventory, documentation and analysis of vegetation in the Riverway area were completed in August of 2000. The area includes the watercourse from the Riverway parkway at Sears Park to Route 9 (Tremont Street). The scope of work included trees, shrubs, vines, and lawn areas including notation of areas of bare lawn and erosion.

Historic Structures

The following are referenced in the Emerald Necklace Master Plan as existing historic structures in the Riverway

- ♦ Huntington Avenue Overpass
- ♦ Back Bay Maintenance Yard
- ♦ Carlton Street Footbridge
- ♦ Longwood Bridge and associated staircase
- ♦ Chapel Street Bridge and Shelter
- ♦ Netherlands Road and Brookline Ave bridges

The Riverway contains a rich assemblage of original bridges, stairs and one of only two surviving park shelters (the Duck House in the Fens being the other). In addition, the

Huntington Avenue Overpass, the Back Bay Maintenance Yard and two major drainage structures post-date the park's inception.

The iron Carlton Street Bridge, currently closed to the public due to deferred maintenance, is in need of extensive rehabilitation. The other bridges are in better condition. They are: the Longwood Bridge (and its associated staircase on the Brookline side), the Chapel Street Bridges with its arches over the watercourse and bridal path (with integral stairs and a shelter building), the bridges at Netherlands Road, Brookline Avenue, the ramps to Route 9, and two pedestrian bridges to the island area.

Four structures, the Longwood and Netherlands Road bridges, the Brookline Avenue Bridge and the ramps to the Huntington Avenue Overpass, carry heavy traffic and are in good condition. The pedestrian portion of the Brookline Avenue Bridge has had stones removed. The most ornate bridge in the park system, the Chapel Street Bridge, appears basically sound, but it needs repair, resetting of stone, and resurfacing for both of its arches. Its associated round shelter overlook requires replacement of its spirally designed roof, some stone resetting, and the reconstruction of its interior floor decking. The Huntington Avenue (Route 9) Overpass has been maintained fairly well.

3.5 Existing Conditions – Leverett Pond (Sector IV A)

The land use around Leverett pond includes the U.S. Veterans Administration Hospital, the New England Home for Little Wanderers, the Museum of Native Americans, and numerous apartment and condominium units. Leverett Pond is in maintenance Sector IV A – Olmsted Park North: Leverett Pond/Daisy Pond.

The inventory, documentation, and analysis of vegetation in the Leverett Pond area were completed in August of 2000 (Table 3.3). The area includes the watercourse from Route 9 to Willow Pond Road. The scope of work includes trees, shrubs, vines, and lawn areas including notation of areas of bare lawn and erosion. The environment surrounding Leverett Pond approximates a maintained urban park more than an unattended urban woodland. Therefore, the biological resources reflect this setting.

Table 3.3 Inventory and Analysis of Existing Vegetation – Leverett Pond

Category	Unit	Total	Good	Fair	Poor	Dead
Trees:						
Canopy tree	each	653	130	406	39	10
Flowering tree	each	62	3	52	7	0
Evergreen tree	each	1	1	0	0	0
Heritage tree *	each	57	12	31	14	0
Total Trees:		803	196	489	110	10
Shrubs:						
	(Estimated)					
Restored planting	square footage	15,143				
Shrub in existing	square footage	8,451				
Total Shrubs:		23,593				
Invasive Plant Colonies:						
	(Estimated)					
Miscellaneous	square footage	0				
Other Invasives (e.g. Knotweed)	(Estimated)	95,000				
Total Invasive Plant Colonies:		95,000				
Woodland:						
	(Estimated)					
	square footage	297,775				

*Note: A heritage tree is a canopy tree with a 3" or greater caliper. If it is listed as a heritage tree, it will not be listed as a canopy tree.

Plan documentation is contained in the Appendices in the form of annotated Existing Conditions Plans.

Leverett Pond is a linearly shaped pond located at the northern end of Olmsted Park, which is highly impacted by passive recreators. The Pond area is bounded on the western side by the Riverway, on the east by the Jamaica Way, on the north by Route 9 and on the south by Willow Pond Road. Leverett Pond is a warm water pond due to the temperature of water from Willow Pond, natural heating, and its inherent shallow depth. The water in Leverett Pond appears turbid as a result of algae growth and suspended sediments.

The Pond is approximately seven acres in size with a maximum depth of approximately six feet. The pond is fed via discharge from Willow Pond. The outlet from Willow Pond consists of a 15' reinforced concrete culvert under Huntington Ave to the Muddy River. There are approximately 0.181 acres of wetlands around the pond. The Village Brook Drain discharges storm water from the surrounding area into Leverett Pond. Stormwater discharge from this drain has caused a great amount of siltation in the pond that has resulted in the formation of sand bars. In addition, there are eight storm drains which also discharge into the pond. Overland flow from the worn path systems around the pond and Daisy Field (ball field) also contribute to the pond's siltation.

The areas around the pond are vegetated by manicured lawn of various grasses with a mature tree canopy. In the majority of areas, the manicured lawn extends to the pond's shoreline. Active planting of shrubs in past years along the western side of the pond has replaced lawn cover. The tree canopy is comprised of sugar maple (*Acer saccharum*), pin oak (*Quercus palustris*), sweet gum (*Liquidambar styraciflua*), black cherry (*Prunus serotina*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), and box elder (*Acer negundo*). Shrubs consist of purple loosestrife, sweet pepperbush (*Clethra alnifolia*) and arrowwood (*Viburnum dentatum*).

Due to the narrowness of the wetlands around the pond, flood storage or sediment retention is minimal. Passive recreation activities have degraded much of the surrounding native vegetation. As a result, invasive species such as purple loosestrife dominate. Principal wetland functions for Leverett Pond include fish habitat and recreation.

The vegetated islands located on the western side of the pond provide good wildlife habitat. Vegetation on the islands consist of river birch (*Betula nigra*), balsam poplar (*Populus balsamifera*), paper birch (*Betula papyrifera*), white ash (*Fraxinus americana*), and tupelo (*Nyssa sylvatica*). The narrow channels between the shoreline of the pond and the islands lend to the diversity of habitats available in Leverett Pond for aquatic species. Furthermore, the islands provide excellent habitat for reptiles, amphibians and avian species. This variety of habitat diversity directly leads to species diversity, which was evidenced by the assortment of aquatic species found in Leverett Pond. Intraspecies comparison amongst the species was observed. The preferred habitat for aquatic species within Leverett Pond is hard-bottomed areas adjacent to steep banks.

The land use on both sides of Leverett Pond is residential, with two exceptions on the eastern side of the Jamaica way. At the northern corner of Leverett Pond, there is commercial land use with a gas station to the east of the Jamaica way. Further south, there is institutional land use with Sherrill House and The Home for Little Wanderers, after which the land use again becomes residential.

Olmsted designed the park as a scenic picturesque park, with activities that were compatible with enjoying the scenery. The pedestrian circulation system around Leverett Pond is extant, except for the portion of the footpath on the Boston side at the southern end. The equestrian path along the Jamaica way has been converted into a bikeway, but its location is extant. On the Brookline side Riverdale Parkway has been converted into a bikeway and limited parking has been added in a structured parking lot on the southern end to accommodate park users, but the footpath is extant from the Olmsted period. Canoeing activities are no longer permitted. The current footpaths and bikeways are used for walking, biking, and running. There are also beaches for sitting and viewing.

The active recreation in the Leverett Pond area consists of two lighted baseball diamonds in Boston's Daisy Field. A structured parking lot at Willow Pond Road accommodates park users of the athletic fields.

Historic Structures

The following are referenced in the Emerald Necklace Master Plan as existing historic structures in Olmsted Park (Sector IV A).

- Cumberland Ave bridge

The granite stone bridges are generally in fair to good condition, except for the puddingstone footbridge at Willow Pond on the Boston side, which was well hidden by overgrown vegetation. The other bridges need minor masonry repair, graffiti and iron stain removal (Cumberland Avenue) and resetting and repointing of stones (Inlet Bridge). Recent mortaring efforts appear inconsistent with historic joints in size, shape and color. The retaining wall along the Jamaica way requires substantial repointing and resetting and extensive clearing of undergrowth.

3.6 Existing Conditions - Willow Pond (Sector IV B)

Willow Pond is also situated in the Olmsted Park portion of the Emerald Necklace. The pond is in maintenance Sector IV B – Olmsted Park South: Ward's Pond/Willow Pond/Nickerson Hill. Steep slopes surround the pond on its eastern, southern and western sides. Olmsted modified the then existing pond by constructing an outlet control at the northern end and removing sediments. The land that is immediately adjacent to Willow Pond consists of vegetated woodlands and grassy parklands with both paved and unpaved paths. Beyond the woodlands to the east is the Jamaica way; to the west is Pond Avenue, which separates the residential areas from Willow Pond. The land use beyond the bordering roadways around Willow Pond is residential.

The Chestnut Street Drain (179 acres) discharges to Willow Pond adjacent to the inlet from Ward's Pond. The Chestnut Street drain has been, and continues to be, a large contributor of sediment to Willow Pond. The three-spine stickleback (*Gasterosteus aculeatus*) inhabits Spring Pond, which is a tributary pond to Willow Pond located to the southeast. The Massachusetts Natural Heritage Program classifies the three-spine stickleback as a rare species. The three-spine stickleback was also found to inhabit a small inlet area in Willow Pond where the water is cool and clean.

The following information on the biological environment includes the existing woodlands, horticultural resources and aquatic and wildlife resources and wetlands. The inventory, documentation and analysis of vegetation in the Willow Pond area were completed in August of 2000 (Table 3.4). The area includes the watercourse from Willow Pond Road to the pedestrian bridge at Ward's Pond. The scope of work includes trees, shrubs, vines, and lawn areas including notation of areas of bare lawn and areas of erosion.

Table 3.4 Inventory and Analysis of Existing Vegetation – Willow Pond

Category	Unit	Total	Good	Fair	Poor	Dead
Trees:						
Canopy tree	each	119	27	79	10	3
Flowering tree	each	7	1	5	0	1
Evergreen tree	each	1	0	1	0	0
Heritage tree ¹	each	3	0	1	2	0
Total Trees:		130	28	86	12	4
Shrubs:						
	(Estimated)					
Restored planting	square footage	1,369				
Shrub massing	square footage	13,764				
Total Shrubs:		15,133				
Invasive Plant Colonies:						
	(Estimated)					
Phragmites	square footage	0				
Other Invasives (e.g. Knotwe	(Estimated)	29,336				
Total Invasive Plant Colonies:		29,336				
Woodland:						
	(Estimated)					
	square footage	223,385				

¹Note: A heritage tree is a canopy tree with a 32" or greater caliper. If it is listed as a heritage tree, it will not be listed as a canopy tree.

Plan documentation is contained in the Appendices in the form of annotated Existing Conditions Plans.

Notwithstanding the present condition of Willow Pond, the aquatic and wildlife resources that are present around Willow Pond are varied in nature, reflecting the diversity and good quality of the surrounding terrestrial and aquatic habitat. These areas include the adjacent woodlands, the inlet stream from Ward's Pond, and the only remaining Olmsted natural history pool, known as Spring Pond.

Willow Pond is fed by water from Ward's Pond, the adjacent Spring Pond, and groundwater seepage. The water in Willow Pond is warm due to the water temperature of Ward's Pond as well as from natural heating and its inherent shallow depth. On the contrary, Spring Pond is well shaded and quite cool and clear year-round, as it is almost totally fed by groundwater discharge. The water in Willow Pond is generally more turbid as a result of algae growth and suspended sediments. A Wildlife Habitat Evaluation and Vegetation Assessment of Willow Pond is contained in Appendix D.

Information on fish resources in Willow Pond was determined through sampling that was conducted as part of the Wildlife Habitat Evaluation and Vegetation Assessment (see

Appendix D). Other data sources were not found. The three-spine stickleback, *Gasterosteus aculeatus*, was found in Spring Pond, and in the small pool immediately below the dam that separates Spring into Willow Pond (Figure 3-5).

The Massachusetts Natural Heritage Program was consulted and while Endangered, Threatened Rare species are not reported to inhabit Willow Pond itself, the three-spine stickleback — [*Gasterosteus aculeatus*] (see Figure 3.5) was reported to be present in the only remaining Olmsted natural history pool (Spring Pond). The presence of the three-spine stickleback was confirmed through use of the electro-shocking sampling technique. The three-spine stickleback was also found to inhabit a small pool in Willow Pond that is immediately below the dam that separates Spring Pond from Willow Pond.



Figure 3.5
Three-Spine Stickleback

Willow Pond is approximately one acre in size. The maximum depth of the pond is approximately ten feet. The pond is fed by water from Ward's Pond via the Babbling Brook and Spring Pond which is one of the original history pools, the Chestnut Street Drain, and groundwater discharge. The outlet to Willow Pond includes a 48" conduit located under Willow Pond Road, which discharges into Leverett Pond. There are approximately 0.82 acres of wetlands around the pond. Wetland types consist of a small amount of emergent vegetation at the outfall of Babbling Brook and a fringe of scrub/shrub throughout. Principal wetland functions and values consist of fish and shellfish habitat, passive recreation, and endangered species habitat.

The majority of the pond's wetlands are classified as scrub/shrub. Shrubs in the area consist of red osier dogwood (*Cornus stolonifera*), sweet pepperbush (*Clethra alnifolia*), American bittersweet (*Celastrus scandens*), weeping willow (*Salix babylonica*), barberry (*Myrica pensylvanica*), and virginia rose (*Rosa virginiana*). A significant stand of emergent vegetation exists at the outfall from Babbling Brook. The emergent vegetation is confined to two small island areas comprised of broadleaf arrowhead (*Sagittaria latifolia*), pickerelweed (*Pontederia cordata*), barnyard grass (*Enhinocloa crusgalli*), jewelweed (*Impatiens capensis*), purple loosersife (*Lythrum salicaria*), rushes and mannagrass (*glyceria candensisI*). The western side of Willow Pond consists of manicured lawn with a shrub fringe, while the eastern side is forested.

The Chestnut Street Drain discharges storm water from the surrounding area (approximately 129 acres) into Willow Pond. The drain has deposited a significant amount of sediment in the pond resulting in the formation of a sandbar. Silt-laden overland flow from the path systems around the pond also contributes to the siltation. It is evident that the water quality of Willow Pond is not as desirable as that of Ward's Pond.

Due to the narrowness of the wetlands surrounding the pond, flood storage capacity and/or sediment retention is considerably hindered. Hydric soils are present in the wetland and are able to retain some flood water.

Animal species observed in Willow Pond include a variety of avians, insects, amphibians, and freshwater fishes. The diverse vegetative community supports a strong diversity of wildlife habitat. In addition, a state listed endangered species, the threespine stickleback (*Gasterosteus aculeatus Linnaeus*), was observed in a portion of Willow Pond adjacent to the outlet from Spring Pond.

Land use immediately adjacent to Willow Pond is vegetated woodlands and grassy parklands with both paved and unpaved paths. Beyond the woodlands to the east is the Jamaica way and to the west is Pond Avenue. Both separate residential areas from Willow Pond.

Olmsted designed the park as a scenic picturesque park, with activities that were compatible with the enjoyment of the scenery. The pedestrian circulation system around Willow Pond is extant, except for a portion of the footpath on the Boston side at the southern end. On the Brookline side Riverdale Parkway has been converted into a bikeway and footpath. The current footpaths are used for walking. There are also benches for sitting and viewing on the Brookline side, but none are located on the Boston side.

The Metropolitan District Commission Kelly Rink constructed in 1965 at the junction of Willow Pond Road and The Jamaica way to the east of Ward's Pond was removed in 1997.

Historic Structures

The following are referenced in the Emerald Necklace Master Plan as existing historic structures in Olmsted Park (Sector IV B).

- Ward's Pond footbridge
- Willow Pond footbridge

The granite stone bridges are generally in fair to good condition, except for the puddingstone footbridge at Ward's Pond on the Brookline side, which was well hidden by overgrown vegetation. The other bridges need minor masonry repair, graffiti and iron stain removal (Ward's and Willow Pond bridges) and resetting and repointing of stones (Inlet Bridge). Recent mortaring efforts appear inconsistent with historic joints in size, shape and color. The Willow Pond and Ward's Pond footbridges were restored in 1983-

84 through a grant from the George B. Henderson Foundation, to the Massachusetts Association for Olmsted Parks.

3.7 Existing Conditions – Ward’s Pond (Sector IV B)

Steep slopes surround Ward’s Pond on its eastern, southern, and western sides. While Ward’s Pond appears to be a kettle hole pond, its shoreline was modified by Olmsted. The land immediately adjacent to Ward’s Pond entails vegetated woodlands with unpaved paths. A wooden boardwalk has been constructed by the BPRD along the southern edge of the Pond to protect the wetlands and to facilitate access and use of the parkland. Beyond the woodlands to the south is Perkins Street, to the east is the Jamaica Way, and to the west is Pond Avenue, which separates the residential areas from Ward’s Pond. The surrounding land use is residential. The pond is in maintenance Sector IV B – Olmsted Park South: Ward’s Pond/Willow Pond/Nickerson Hill (Figure 3.6).

Figure 3.6 Olmsted Park



Source: VHB, Inc.

The resources discussed in this section include upland woodlands, horticultural resources, the aquatic and wildlife resources and wetlands.

The inventory, documentation and analysis of vegetation in the Ward’s Pond Area were completed in August of 2000. The area includes the watercourse from the pedestrian bridge at Ward’s Pond to Perkins Street. The scope of work includes trees, shrubs, vines, and lawn areas including notation of areas of bare lawn and areas of erosion (Table 3.5).

Table 3.5 Inventory and Analysis of Existing Vegetation – Ward's Pond

Category	Unit	Total	Good	Fair	Poor	Dead
Trees:						
Canopy tree	each	136	7	114	15	0
Flowering tree	each	2	1	1	0	0
Evergreen tree	each	0	0	0	0	0
Heritage tree ¹	each	24	1	17	6	0
Total Trees:		162	9	132	21	0
Shrubs:						
	(Estimated)					
Restored planting	square footage	0				
Shrub massing	square footage	861				
Total Shrubs:		861				
Invasive Plant Colonies:						
	(Estimated)					
Phragmites	square footage	0				
Other Invasives (e.g. Knotweed)	square footage	21,535				
Total Invasive Plant Colonies:		21,535				
Woodland:						
	(Estimated)					
	square footage	199,247				

¹Note: A heritage tree is a canopy tree with a 32" or greater caliper. If it is listed as a heritage tree, it will not be listed as a canopy tree.

The aquatic and wildlife resources present at Ward's Pond are of a diverse nature and reflect the diversity and good quality of the surrounding habitat as well as the aquatic habitat. Because groundwater seepage as well as direct flow feed to Ward's Pond from Jamaica Pond, the water is clear, well oxygenated, and provides for a healthy aquatic habitat. The water is warm, however, due to the temperature of water from Jamaica Pond.

Ward's Pond is located at the southern-most section of the project area. This portion of the Emerald Necklace is least impacted by pedestrians and has minimal urban development; thus it remains the most natural environment within the Muddy River system. Steep banks that lead to Jamaica Way bound the Pond on the southern and eastern perimeter and the Riverway (roadways).

Ward's Pond is approximately three acres in size. The maximum depth of the pond is approximately five feet. The pond is fed by three water sources: a 4' x 3' brick culvert from Jamaica pond, an 8" overflow pipe from Jamaica Pond, and groundwater seepage. There are approximately 0.65 acres of wetlands around the pond. Wetland types consist of emergent in some areas and scrub/shrub throughout.

The sound water quality of Ward's Pond supports a diverse and healthy wetland population. No manicured lawns and little erosion of the banks exist at Ward's Pond.

Most of the pond's wetlands are classified as scrub/shrub. Shrubs in the area consist of glossy buckthorn (*Rhamnus frangula*), weeping willow (*Salix babylonica*), river birch (*Betula nigra*), gray birch (*Betula populifolia*), paper birch (*Betula papyrifera*), and arrow wood (*Viburnum dentatum*). The herbaceous layer of plants consist of jewelweed (*Impatiens capensis*), sensitive fern (*onoclea sensibilis*), and purple loosestrife (*Lythrum salicaria*). In many places there are healthy emergent vegetated wetlands extending into the water. Such species include narrow-leaved cattail (*Typha angustifolia*), swamp loosestrife (*Lysimachia terrestris*), and lily pads. The principal wetland function/values for this wetland system are wildlife habitat, recreation, and product export. The wetlands do function to retain sediments and toxicants and remove nutrients. However, due to the relative narrowness of the wetlands, this is not a principal system.

The southwest portion of the pond receives a large amount of groundwater via seepage from the hillside. The groundwater is filtered through the emergent/shrub wetland and eventually discharges into the pond.

Due to the narrowness of the wetlands around the pond, flood storage capacity is very low. Hydric soils are present around the wetland and are able to retain some floodwater. There are no storm drains or drainage swale outfalls leading to the wetlands or the pond. However, overland flow may occur. The wetlands do filter some sediments and restrain toxicants from entering Ward's Pond.

Wildlife species observed in Ward's Pond include a variety of freshwater fishes, insects, amphibians, and avian species. The vegetative community supports a strong diversity of wildlife habitat. The clear water quality of Ward's Pond indicates that sediment retention may occur in the wetland. These wetlands are of high importance because of the potential sources of sedimentation upgradient of the pond (i.e. The Riverway and Jamaicaway).

Ward's Pond is bordered by residential land use on the east and west and the park to the north and south. Ward's Pond is principally a passive area, but has unorganized active recreation with woodland trails for walking and running. Currently there are no benches around the pond.

Historic Structures

The following are referenced in the Emerald Necklace Master Plan as existing historic structures in Olmsted Park (Sector IV B).

- ♦ Ward's Pond footbridge
- ♦ Willow Pond footbridge

The granite stone bridges are generally in fair to good condition, except for the puddingstone footbridge at Ward's Pond on the Brookline side, which was well hidden by overgrown vegetation.

CHAPTER 4: MAINTENANCE PLAN

4.1 Introduction

Current maintenance personnel for the Muddy River parks consist of a combination of Boston Parks staff, Brookline Parks staff, and staff from the DCR, Division of Urban Parks. In recent years, and particularly since Proposition 2 ½, park departments in Massachusetts have suffered from increasing demands and decreased resources. This has resulted in degraded park systems due to insufficient levels of maintenance and/or deferred maintenance. The most significant issue facing the respective Parks agencies undertaking the Muddy River Restoration Project is the level of maintenance required to retain the character-defining features of the historic Emerald Necklace landscape, particularly related to vegetation management, visitor use and impacts, and the care of bridges, roads and structures.

One objective of the Muddy River Management and Maintenance Plan is to identify the gap between the current level of maintenance and the level that will be required once the Muddy River Restoration project is complete. The Plan was created to incorporate maintenance and management operations into the framework of the parks' historic design. Developing appropriate maintenance standards includes analysis of performance, management, staffing levels, training, funding, large and small engine equipment as well as an understanding of the historic landscape design intent.

As the result of interviews with city, town and state park staff, site observation, and benchmarking standards developed by the National Recreation and Park Association and the Professional Grounds Management Society, it is estimated that 34,679 Net Productive Time (NPT) hours will be needed annually to bring the Muddy River park maintenance to a higher level. NPT and associated maintenance tasks are discussed in this chapter.

This Plan recommends specific maintenance practices and guidelines for the Muddy River park system. The budget and staffing figures are all based upon ETM's analysis using FY 04 and FY 04 data. This section begins with park-wide maintenance recommendations that are pertinent to the park system as a whole and continues with specific maintenance activities for landscape types within each park sector.

4.2 Methodology for Establishing the Muddy River Maintenance Standards

Through a series of meetings, interviews with staff and senior management, and research it was determined that the exceptional landscape maintenance at the Arnold Arboretum was an appropriate standard of maintenance for the Muddy River parks of the Emerald Necklace. The Arnold Arboretum has approximately 232 acres requiring regular maintenance and is broken down as follows:

- 120 acres of mowed lawn of which approximately 50% is mowed only 2-3 times annually
- 5 acres of water

- 90 acres of naturalized vegetation including woodlands, wetlands and meadows
- 3 acres of greenhouse and nursery
- 14 acres of gardens

The analysis of time needed to achieve the maintenance standard of the Arnold Arboretum considered the cost per square foot as the baseline and then considered maintenance standards and work activities based upon the Muddy River park landscape design.

4.2.1 Setting a Higher Maintenance Standard

Using the Arboretum as the park maintenance standard, a square foot cost for maintenance was developed as a reference point for evaluating maintenance costs for the Muddy River parks of the Emerald Necklace (noting also that there are many differences and variables that exist between the two sites).

The Arboretum square foot maintenance cost is \$0.07/ square foot as determined by the annual operating budget, percent salaries and total square feet:

- The annual operating budget for landscape maintenance excluding the greenhouse, nursery and water is \$962,000.
- In most parks, approximately 65-75% of the annual operating budget is salaries. Using 70%, approximately \$674,000 is spent annually at the Arboretum on salaries.
- Total Square Feet equals total acres with the exception of water multiplied by the amount of square feet in an acre. $224 \text{ acres} \times 43,560 \text{ sq. ft/acre} = 9,757,440 \text{ total square feet}$.

Thus, the annual cost for salaries divided by the total square feet = cost per square foot. $\$674,000 \text{ divided by } 9,757,440 = \$0.07/\text{sq. ft.}$

Based upon contemporary use and the historic design of the park, a higher square foot cost of \$0.10/sq. ft. is assessed for the Muddy River parks of the Emerald Necklace. As a point of reference, the estimated cost for maintenance of Prospect Park in New York City is \$0.12/sq. ft. \$0.10/sq. ft was determined by ETM to be a reasonable estimate for the Emerald Necklace due to the design of the park, location and use.

The Arboretum has 12 full-time staff, 1 Apprentice (0.75 FTE) and 10 summer interns (seasonal) performing park maintenance. The Arboretum has 1 FTE devoted to delitering and emptying the 25 trash cans spread throughout the Arboretum.

Key factors for higher maintenance standards at the Arboretum are:

- Dedicated park staff
- Skilled staff
- Stable full-time staff with knowledge and commitment to maintenance of the Arboretum

- Combination of staff who are equipment operators, horticulturalists and 3 certified climbing arborists. (2/3 of ALL of the full time grounds maintenance staff have MA Certified Arborist credentials).

It should be noted that the Arboretum is, strictly, not a public park. While open to the public, the Arboretum is first and foremost a research facility and many management decisions are made from a curatorial perspective. The Muddy River parks of the Emerald Necklace, on the other hand, are well-used public spaces. Management and policy decisions are made in this context.

A large portion of both the Muddy River parks of the Emerald Necklace (23%) and the Muddy River Restoration Project (54%) is water. Calculating maintenance of the water is complicated as it includes not only park-related costs but also costs included in Best Management Practices that may be shared by the different entities on a watershed ownership basis. For the purposes of calculating estimated maintenance hours and costs for this report, water (with the exception of litter and debris removal) is not included and will be investigated separately in Chapter 7 (Stormwater Management/Pollution Control) of the SFEIR and by the ACOE in their maintenance plan. The maintenance recommendations for this plan address only the landscape portion of the Muddy River parks.

$$\$0.10 \times 6,186,000 \text{ sq. ft. (142 acres} \times 43,560 \text{ sq. ft./acre)} = \$618,600$$

Assume an average salary cost of \$30,000/employee;

$$\frac{\$618,600}{\$30,000/\text{FTE}} = 20.7 \text{ Total FTE's}$$

This square foot cost is a starting point for estimating future maintenance costs.

4.2.2 Classification

A good classification system lends itself to work measurement and the application of work standards; it supports management decision-making at all levels (i.e., in deploying personnel and equipment), and is based on understanding the nature of park maintenance work.

Three critical variables condition the analysis of park maintenance work: 1) the nature of the task, 2) skill levels of those performing the task, and 3) the physical setting. For example, cleaning a paved surface is different from cleaning a densely wooded one, both in type of equipment used and in the time it takes per acre.

Maintenance tasks for the Muddy River parks have been classified into five areas as indicated below. Based upon this classification, specific landscape types and the level of maintenance required based upon the specific landscape design of the Muddy River parks, have been identified.

- ♦ General Maintenance – Work having to do with the appearance of the park and sanitary conditions, including litter pick-up and collection of trash from receptacles.
- ♦ Horticultural Care - Work having to do with the care of shrubs, perennials, small trees, turf and woodlands.
- ♦ Repair and Preservation – Work having to do with the proper functioning and safety of park equipment and facilities, preventative maintenance, historic structure preservation and repair. Examples include: repair of park lighting, bench painting and repair, park structure maintenance, and graffiti removal.
- ♦ Operations/Special Events – Work related to the use of park facilities and equipment. This work is often seasonal or special event related, such as setting and removing barricades.
- ♦ Water Body Management – Work related to maintaining the proper health of park water bodies including monitoring, cleaning, edge repair, and removal of invasive vegetation.

4.2.3 Relationship between Usage and Maintenance

Park users not only greatly increase the time required to repair and maintain a park's physical setting, but also create daily litter of all types. Cleaning up after visitors is the most time-consuming park task. Services to special park users, such as special events and organized recreational groups, also add a considerable amount of work, especially during the peak summer season.

In general, the greater the number of users in and around parks, the greater the amount of maintenance work that needs to be done. How long people stay and what they do when they get there is also important. Five busy vandals can create more work than 1,000 people strolling through a park.

Maintenance also impacts use. If parks are dirty, benches are broken, and ball fields are not playable or open, people will not enjoy the parks as much, and eventually they may stop usage. If parks are well maintained, the number of visitors will increase.

Given the interdependence between maintenance and use, the goal of this Plan is to ensure that the parks “keep up”. Maintenance recommendations are determined in order to ensure that an increase in park users is mirrored by an increase in the quality and quantity of park maintenance.

4.3 Measuring Workload

In a complex maintenance environment such as the Muddy River Parks, many different kinds of work measures need to be considered: amount of work; quality of work; frequency; speed (amount of work per unit of time); and time to complete. The different

work measures are inter-related – one can usually complete a task more quickly by compromising on the quality of work.

External or uncontrolled variables affect workload and complicate work measurement: the impact of use (the number of users and their behavior, i.e., vandalism, special events); the intensity of use (i.e., heavy use during large special events); the culture or style of the workplace; the physical conditions (i.e., terrain and weather); and the difficulty of the task itself and skill level possessed by the staff.

Deferred maintenance, capital projects in process, and future capital projects all have an impact on workload. In the Muddy River parks of the Emerald Necklace, the primary variables are the park's physical variations, the culture or style of the workplace and future capital projects. The Plan recommendations take into consideration all of these factors.

4.3.1 Measuring Current Work

The process of measuring current maintenance work involved interviews, observations, and information provided by Boston, Brookline and the Commonwealth of Massachusetts. The following is an outline of the methods used:

- Interviews were conducted with senior managers and field staff of all three entities to elicit information on current staffing and operations
- Review of existing organizational charts, budgets and work schedules
- Site walks and park tours
- Interviews with members of the Citizens Advisory Committee
- Interviews with the Emerald Necklace Conservancy

In order to measure current productive time the following are considered:

Total Time

- The base unit for measuring potential productive work is the number of hours a person works during one year. The total number of hours is the maximum someone can work, deducting weekends.

Off-the-Top Deductions

- Total time represents only a starting point in calculating the productive time of the work force. Workers are entitled to a certain number of holidays and vacation days, excused absences, emergency absences and time for breaks.

Lost Time

- Lost time includes sick leave, leave without pay, workers compensation, and Family with Medical Leave Act. No worker is constantly productive, nor is any organization perfectly efficient.

Non-Productive Time

- Non-productive time is spent away from work including travel time, trips to the dump, change and wash up, and waiting time for vehicles or equipment.

Lost Time Due To Inclement Weather

- In times of inclement weather (rain and snow), less outside maintenance work can be completed.

4.3.2 Current Maintenance Practices

Current maintenance standards vary throughout the Muddy River parks of the Emerald Necklace. A site walk on August 4th, 2001 revealed discrepancies in maintenance standards and practices. Many areas differed in:

- Maintenance – degree thereof
- Mowing standards and practices – degree thereof
- Erosion – extent thereof
- Bench treatments
- Trash containers
- Path edges – maintenance
- Lawn – maintenance, renovation and usage
- Tree maintenance – degree thereof
- Walkway materials – consistency
- Plant maintenance – due to the type of materials selected or neglect
- Graffiti – degree thereof on walls and trash receptacles

The inability to maintain newly improved areas is a serious cause for concern, reflecting that existing resources can do little more than keep up with basic park maintenance. Additional maintenance resources will be needed to meet and sustain the workload from newly completed capital projects, particularly the Muddy River Restoration Project.

While a cursory inspection indicates that existing park maintenance is basically acceptable, a closer look shows that many areas have deteriorated: overall turf standards need improvement, extensive tree care is needed, horticultural care is lacking and there is little or no existing woodland management or water body maintenance efforts. In other words, only basic park maintenance, cleaning, mowing, and some limited tree work, is currently being done. The lack of uniform standards and practices exhibits the fact that multiple entities share maintenance responsibilities.

It should be noted that new plantings near Leverett Pond in Brookline highlighted a serious current and future maintenance problem. The particular variety of rose, Memorial Rose, selected for the planting areas has serious maintenance implications. The Memorial rose is a very aggressive grower and quickly spreads beyond the boundaries of the planting area. In addition, access by maintenance staff is very difficult due to the dense spreading nature of the plant and its small thorns. The inability of the maintenance staff to “wade” into these planting beds to weed and remove litter results in insufficient maintenance. In this particular instance, it is not insufficient staffing but rather the

species of the plant material itself which makes maintenance very difficult, if not impossible. Plant material should be selected not only for its historic and environmental appropriateness, but also the ability of staff to maintain it.

Given the current staffing levels, it is understood that little more than basic maintenance can be done.

4.3.3 Existing Staffing

Calculations for existing full time equivalents were developed to reflect the actual percentage of time maintenance staff spent in the Muddy River parks of the Emerald Necklace.

- Boston Parks and Recreation: A crew of 4 spends approximately 80% of its time in the Muddy River parks of the Emerald Necklace which equates to 3.2 FTEs, while the Parkman horticulture crew of 3 spends about 40% of its time or 1.2 FTEs. Boston maintenance staff is augmented by 1.1 FTE of supervisory support provided by the Director of Historic Parks (50%), a Historic Park Landscape Architect (20%), and the Parkman Funds contract Project Manager (40%).
- Brookline Parks and Open Space: Two zone maintenance crews of 4 persons each spend 15% of their time in the Muddy River parks of the Emerald Necklace or 1.15 FTE, while Forestry spends .1 FTE. Brookline maintenance staff is augmented by .6 FTE supervisory support provided by an Arborist (5%), Operations Manager (10%) and Landscape Architect (5%).
- DCR: A DCR maintenance crew of 4 persons from the Charles District spends approximately 25% of its time in the Muddy River parks, which equates to 1.0 FTE. DCR maintenance staff is supplemented with supervisory staff equal to .1 FTE.

The estimated current staffing in the Muddy River parks of the Emerald Necklace by maintenance field staff and supervisors is shown in Table 4.1.

Table 4.1 Current Full Time Equivalent Staff Project Area

<i>Organization</i>	<i>Work Force</i>	<i>Managers/ Supervisors (FTE)*</i>	<i>Workers (FTE)*</i>
Boston	M & O	.3	3.2
	Horticulture	.4	1.2
	Forestry	.1	.3
	Trades	.2	1.2
Brookline	M & O	.5	.75
	Horticulture	.25	.4
	Forestry	.25	.1

	Trades	.1	.25
DCR	M&O	.1	1
Total	10.6	2.2	8.4
*FTE = Full Time Equivalent M&O Maintenance & Operations from ETM Associates, L.L.C.			

4.3.4 Net Productive Time

The total time or potential productive work hours per year for the Muddy River Parks is 260 days per year, times 8 hours a day, times a staff of 10.6 (FTE), for a total of **22,048 hours**. After all the deductions are subtracted (520) from the total time available (TTA), 2080, the net productive time (NPT) per worker is approximately 1,560 hours per year (2080 – 520 hrs). The estimated net productive time for existing park maintenance is:

10.6 F.T.E. x 1,560 hrs/year, which equals 16,536 net productive hours/year for maintenance work in the Muddy River parks of the Emerald Necklace.

4.3.5 Supplementary Available Hours

There are also other private partners or contractors that contribute to the maintenance of the Muddy River parks including:

- Tree and Landscape Maintenance Contract Work
- Correction Department Workers
- Boston Youth Fund (seasonal)
- Parkman Contract Work
- City Year and Volunteers – currently minimal
- “Park Partners”

Based on staff interviews, it is estimated that the total supplementary work hours for the Muddy River parks of the Emerald Necklace is 2,000 – 3,000 annually.



Parks staff removing Japanese Knotweed

4.4 Proposed Staffing

The Muddy River parks suffer from an insufficient number of staff members to manage and maintain the park. In addition to hiring additional laborers or services, the park needs professionals skilled in the management and maintenance of historic landscapes, structures, horticulture and water resources.

4.4.1 Setting Higher Maintenance Standards

The Muddy River Restoration Project will increase the gap between available and needed maintenance hours. While under construction, the areas affected by capital projects are usually closed off to the public for the duration of the project, which slightly reduces the total maintenance workload. When completed and reopened, the renovated Muddy River parks will add to the existing park maintenance load.

When the Muddy River Restoration Project is completed, there will be an increase of 24.5 acres of newly restored landscape including 15 acres of lawn, 8.15 acres of planted areas and 215 new trees requiring regular maintenance, after the two-year maintenance guarantee period expires. Table 4.2 depicts the increased planting from the Muddy River Restoration Project. One of the planting requirements recommended by the Citizens Advisory Committee (CAC) is that the Contractor(s) be required to maintain all plant materials for two years after acceptance of the work. The specifications for the two-year maintenance period associated with Charlesgate are included in Appendix B. It is recommended that the Charlesgate specifications be adapted to meet the requirements of the newly landscaped areas in the park based upon the final landscape design. However, based upon recent experience at Charlesgate, it may be more advantageous to hire a skilled landscape maintenance contractor to perform the work.

Maintenance for the new plant material during the two-year maintenance period includes:

- Watering
- Fertilization
- Weeding
- Mulching
- Disease and Pest Control
- Plant Replacement
- Control of Invasives

Table 4.2 Increased Planting from Muddy River Restoration Project

<i>Project</i>	<i>Trees</i>	<i>Low Shrubs (sq.ft.)</i>	<i>Medium Shrubs (sq.ft.)</i>	<i>High Shrubs (sq.ft.)</i>	<i>Lawn Areas (sq.ft.)</i>	<i>Wetland Plants (sq.ft.)</i>	<i>Perennial (sq.ft.)</i>
Wards Pond	1	2,425	2,875	1,750	8,350	2,360	1,625
Willow Pond	7	20,175	4,900	13,660	23,720	1,650	4,700
Leverett Pond	24	21,088	7,835	1,468	112,615	3,860	

Riverway	57	51,308	51,955	34,345	110,480	18,090	
Sears Parking Lot	28	7,700	3,050	5,400	25,200	1,260	
Back Bay Fens	98	24,635	59,515	34,450	389,100	32,330	
Total Trees	215						
Total (square feet)		127,331	130,130	91,073	669,465	59,550	6,325
Total (acres) 24.5		3	3	2	15	1.3	0.15

From ETM Associates, L.L.C.

The contractor would be responsible for **only** those areas within the contract area. It is likely that other landscape areas located outside and/or adjacent to the contracted area will need mowing, horticulture care, delittering and emptying of trash receptacles, etc. during the two-year maintenance period.

Once the two-year maintenance period ends, Boston, Brookline and the DCR will resume maintenance within their respective jurisdictions. The proposed construction schedule for the Muddy River Restoration Project extends from 2004 thru 2011. The two-year maintenance period will follow completed capital construction. Increased agency maintenance responsibilities will be phased, with the greatest maintenance impact occurring between years 2008-2010. The DCR will be responsible for the Charlesgate project area in early 2005; Boston will assume increased maintenance responsibilities beginning in early 2008 and Brookline in early 2010.

It is estimated that a total of 18,688 NPT hours will be needed annually just to maintain the newly restored Muddy River Restoration Project areas. Table 4.3 summarizes the additional hours of maintenance required.

Table 4.3 Summary of Additional Hours for Each Entity

	<i>Hours at Current Standards</i>	<i>Additional Hours Needed</i>	<i>Hours at Higher Standards</i>	<i>Muddy River Restoration Project Impact</i>
General Maintenance	8,387	9,713	18,100	8,783
Boston	5,368	6,216	11,584	5,621
Brookline	1,426	1,651	3,077	1,493
DCR	1,594	1,846	3,439	1,669
Horticultural Care	3,155	8,888	12,043	6,998
Boston	2,019	5,689	7,708	4,479
Brookline	821	1,226	2,047	1,190
DCR	315	1,973	2,288	1,329

Repair/Preservation	1,562	1,449	3,011	1,035
Boston	1,200	727	1,927	662
Brookline	362	150	512	176
DCR	0	572	512	197
Operations/Special Events		1,525	1,525	656
Boston		976	976	420
Brookline		259	259	112
DCR		290	290	124
Totals are for field staff and do not include supervisory or management staff From ETM Associates, L.L.C.				

4.4.2 Gap Analysis

The estimated amount of maintenance time required by the Muddy River parks of the Emerald Necklace is 34,679 hours annually, as shown in Table 4.4. The gap between needed NPT hours and total NPT hours available is estimated to be 21,575 hours, which equals 13.8 FTE's as calculated by NPT.

Table 4.4 Hours Needed to Maintain the Project Area Parks

	<i>Hours of Current Standards</i>	<i>Muddy River Restoration Project Impact**</i>	<i>Total Hours of Higher Standards</i>	<i>Additional Hours</i>
General Maintenance	8,387	8,400	18,100	9,713
Horticultural Care	3,155	7,470	12,043	8,888
Repair/Preservation	1,562	1,868	3,011	1,449
Operations/Special Events		950	1,525	1,525
Totals*	13,104	18,688	34,679	21,575
* Totals are for field staff, and do not include supervisor or management staff. ** Included in Hours at Higher Standards From ETM Associates, L.L.C.				

The total number of additional hours needed by each party in order to achieve the higher maintenance standards for their portion of the project area is:

Boston	13,600 hours = 8.7 FTE's
Brookline	3,300 hours = 2.1 FTE's
DCR	4,700 hours = 3.0 FTE's

The challenge is to develop strategies that will close as much of the gap as possible through:

- Better management
- Increased staff productivity
- Use of outside contractors
- Reducing non-productive time
- Increased staff

Again, once the two-year maintenance period ends, Boston, Brookline and the DCR will resume maintenance within their respective jurisdictions. The proponents will work with the contractors to transition maintenance activities to the respective property owners. The proposed construction schedule for the Muddy River Restoration Project extends from 2004 through 2011. The two-year maintenance period will follow completed capital construction. Increased agency maintenance responsibilities will be phased, with the greatest maintenance impact occurring between years 2008-2010. The DCR will be responsible for the Charlesgate project area in early 2005; Boston will assume increased maintenance responsibilities beginning in early 2008 and Brookline in early 2010. The increase in relative FTE's with a phased schedule based upon the current construction and maintenance contract is provided in Table 4.5

Table 4.5 Maintenance Increases Following Project Construction

<i>Property Owner</i>	<i>Hours at Current Standards</i>	<i>Hours at Increased Standards</i>	<i>Increase in Maintenance Hours Per Year</i>					
			<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>
DCR: Current FTE 1.1 Percentage of Additional Hours or FTEs sequenced with Park Construction Phased Increase in Hours (Current hours plus percent increase of total hours at higher standard at \$32.00/Hr) Phased Increase in FTE's (Current FTE plus percent increase of total FTE at higher standard) **Please note that DCR numbers go to the curb only (25' into park) and do not include the parkways.	1909 Hrs \$47,725	6529 Hrs \$163,225	30% 1959 \$87,275 2.00	40% 2612 \$93,925 2.3	50% 3265 \$105,475 2.6	60% 3917 \$117,025 2.9	80% 5223 \$140,125 3.5	100% 6529 \$163,225 4.1
Boston: Current FTE 6.9 Percentage of Additional Hours or FTEs sequenced with Park Construction Phased Increase in Hours (Current hours plus percent increase of total hours at higher standard at \$32.00/Hr) Phased Increase in FTE's (Current FTE plus percent increase of total FTE at higher standard)	8587 Hrs \$274,784	22195 Hr \$710,240				60% 13317 \$536,057 12.12	80% 17756 \$623,148 13.86	100% 22195 \$710,240 15.6
Brookline: Current FTE 2.6 Percentage of Additional Hours or FTEs sequenced with Park Construction Phased Increase in Hours (Current hours plus percent increase of total hours at higher standard at \$32.00/Hr) Phased Increased in FTE's (Current FTE plus percent increase of total FTE at higher standard)	2609 Hrs \$83,488	5895 Hrs \$188,640					60% 3537 \$146,579 3.86	100% 5895 \$188,640 4.7

The next section identifies specific maintenance performance standards and activities per park area that will be performed within each jurisdiction.

4.5 Classification of Park Sectors within the Emerald Necklace-Muddy River Parks

The Muddy River parks of the Emerald Necklace has been divided into 7 sectors for analysis, planning and implementation purposes. Maintenance needs and the characteristics of the physical areas have been taken into account. These are:

Sector I:	Charlesgate
Sector IIA:	Back Bay Fens North: Victory Gardens/Mother's Rest
Sector IIB:	Back Bay Fens Central: Rose Garden/Clemente Field
Sector IIC:	Back Bay Fens South and Sears Parking Lot
Sector III:	Riverway
Sector IVA:	Olmsted Park North: Leverett Pond/Daisy Pond
Sector IV B:	Olmsted Park South: Wards Pond/Willow Pond/Nickerson Hill

The physical areas within each Sector of the Muddy River parks are further subdivided into landscape types.

4.6 Landscape Types

The Muddy River parks of the Emerald Necklace consist of different landscape types requiring different maintenance needs based upon the historic design intent:

- ♦ **Parkland** (turf, meadow and athletic fields) – park areas characterized by grassland covered by a tree canopy. This is the predominant landscape type found in the Muddy River parks of the Emerald Necklace and requires intensive maintenance. Grass needs to be mowed and maintained on a regular schedule, litter picked up, and trees pruned and maintained. Higher standards of turf care, reseeding, fertilizing, aeration, and soil testing are needed to ensure a high quality turf. This plan identifies three levels of turf maintenance and separately addresses maintenance for meadow grass and athletic fields.
- ♦ **Planting Areas** (shrubs and perennials) – these areas are characterized by plantings of ornamental shrubs and perennials. Understanding the character of these plantings will be important to performing proper maintenance practices. Some plantings will need regular pruning or trimming (hedges) while others will be allowed to grow with limited pruning to reach their desired height and character. This plan identifies three levels of planting areas and one level of garden maintenance.
- ♦ **Woodlands** – natural areas characterized by the Ward's Pond area with less intense usage. These areas should be managed as woodlands requiring low levels

of maintenance. However staff with specialized skills, particularly in urban forestry or woodland management is needed. This plan identifies two levels of woodland maintenance.

- ♦ **Embankment Plantings** – plantings along the water edge will need regular maintenance including removal of invasive plant species. As a mature landscape with considerable use, the Muddy River parks of the Emerald Necklace suffer from numerous erosion problems. Controlling erosion and run-off helps prevent long-term degradation of the waterways. It also significantly improves the appearance of the parks. This plan identifies three levels of embankment planting maintenance.
- ♦ **Water** – the Muddy River as well as the lakes and small streams will need monitoring, cleaning and removal of invasive vegetation. Specialized skills are needed to monitor and maintain water quality throughout the Muddy River parks of the Emerald Necklace. This plan identifies two levels of watercourse maintenance.
- ♦ **Site Furnishings** – this includes benches, trash cans, and signs needing regular maintenance. Park furniture, such as benches, trashcans, catch basins, soft surface paths— which are easy to overlook and make a second priority—need regular maintenance. This plan identifies one level of maintenance for site furnishings, three levels of maintenance for trash removal, two levels of maintenance for paved surfaces, and two levels of maintenance for graffiti removal.
- ♦ **Structures & Bridges** – owners of the Muddy River Parks should evaluate the significance of historic buildings and guide preservation efforts accordingly. All structures and bridges within the Muddy River Parks should be managed and maintained with the goal of preserving the historic authenticity and structural integrity of the buildings. This plan identifies three levels of maintenance for structures.

4.7 Measurable Performance Standards

The maintenance activities as described under each landscape type have been analyzed using the Arnold Arboretum of Harvard University as the standard for excellent maintenance. For each individual activity a work description has been formulated, these descriptions take the form of performance standards detailing how each activity should be performed and to what end result. Maintenance for each landscape type is classified as Level I, Level II or Level III depending on the intensity and frequency of maintenance activities. Landscape types with Level I maintenance are maintained at a high level of care or intensity, while landscape types classified as Level III receive less frequent maintenance and are kept in a more natural state. Table 4.4 summarizes the landscape type, level and performance standard.

Table 4.6 Measurable Performance Standards

Landscape Type	Level	Performance Standard
Turf	I	Mowed to height of 3 inches every 5-7 working days.
Turf	II	Mowed to height of 4 inches every 7-12 working days.
Turf	III	Mowed to height of 4.5 inches every 14-18 working days.
Meadows	I	Meadow grass no higher than 2 feet.
Meadows	II	Meadow grass no higher than 2.5 feet.
Athletic Fields	I	Mowed to height of 2.5 to 3 inches with zero infield depressions.
Planting Areas	I	Less than 10% weeds and 5% deadwood in bed.
Planting Areas	II	Less than 10% weeds and 10% deadwood in bed.
Planting Areas	III	Less than 10% invasives.
Gardens	I	Less than 5% weeds.
Woodlands	I	Less than 5% invasives and less than 5% deadwood.
Woodlands	II	Less than 10% invasives and less than 10% deadwood.
Embankment Plantings	I	Less than 5% trash, less than 5% exposed soil, 90% planting density and less than 5% weeds and/or invasives.
Embankment Plantings	II	Less than 5% trash, less than 5% exposed soil, 90% planting density and less than 10% weeds and/or invasives.
Watercourse	I	Less than 2% trash.
Watercourse	II	Less than 5% trash.
Trash Removal	I	Zero overflowing cans.
Trash Removal	II	Zero overflowing cans.
Trash Removal	III	Zero overflowing cans.
Paved Surfaces	I	Less than 2% in degraded condition.
Paved Surfaces	II	Less than 5% in degraded condition.
Park Furniture	I	Inspected weekly and routine repairs are done within 3-5 working days.
Graffiti Removal	I	Graffiti removed within 24 hours.
Graffiti Removal	II	Graffiti removed within 48 hours.
Structures	I	Less than 5% in degraded condition

4.8 Proposed Maintenance Practices

The Muddy River Maintenance Plan contains information on the work method, the daily productivity, the resources required and the time of year for each operation. Full details of the maintenance operations, schedule, and resource requirements for each activity are contained in the Maintenance Calendar in **Appendix A**. The table also shows the landscape type or feature to which the activity is applied.

4.8.1 Parkland: Turf, Meadow and Athletic Fields

Goal: Restoration of turf areas through improved soil health and the establishment of a low-input, sustainable and ecologically sound turf-care program that includes regular maintenance and the definition of differential cutting areas.

The soil in the landscape is the most important natural resource in the park. A healthy soil sustains all plant life, including trees, shrubs and especially the turf. A large part of the parks have grass as a ground cover. Generally less tree cover over grass results in more light and moisture, requiring more frequent mowing in order to maintain a specified length of grass. The required length of grass will depend on the desired use of the space and the actual climatic conditions experienced. Sports turf areas, which sustain heavy levels of use, require a much higher level of maintenance than do more passive park areas. Equally, in periods of drought, grass will be cut higher and less frequently to reduce stress. The size of the area is probably the most important factor influencing maintenance. Large areas, free from obstructions can accommodate large, efficient grass cutting machinery. Small areas with mowing obstructions such as lights, signs, benches, litter bins and trees must be mown by smaller, slower equipment.

4.8.1.1 General Guidelines for Turf Care:

No maintenance operation affects the appearance of a park more dramatically than mowing. Mowing is the heart of turf care. A well-groomed patch of weeds can present a pleasing appearance while poorly groomed turf of the finest available grass will look poor. Without mowing, most turf grasses will grow to heights of 2 to 3 feet. Limiting turf to 2" to 2 ½" (for athletic fields) puts tremendous stress on the plant and increases the level of necessary inputs, especially irrigation. Turf that is cut higher (3-4") is better able to withstand the pressures of foot traffic, equipment traffic and drought. Proper mowing practices and equipment minimize this stress. Grass clippings are to be left on all turf areas including athletic fields. This practice will decrease fertilizer requirements, increase the health of the turf's root system, and eliminate the need for disposal or composting of grass clippings.



Turf areas in Olmsted Park.

Select soil tests need to be done on an annual basis. Without the information from a soil test, all management decisions regarding the soil result in guesswork. Soil tests should be conducted in early spring (March). Soil pH for turf should be between 6.0-6.5. Base saturation for potassium (K) should be 2-4%; magnesium (Mg) should be approximately 14%; and calcium (Ca) should be 60-70%.

Turf Level I is the highest maintenance grass (with the exception of the athletic fields) in the park system. The high maintenance areas are either large turf areas such as the Fens or small areas that are usually long and thin and are found around water edges or along the Riverway. The intention in this category is to achieve well-maintained grass that is often dotted with trees.

- **Maintenance Standard - Turf Level I: Mowed to height of 3” every 5-7 working days.**

Annually, the turf is evaluated for restoration, aeration, overseeding, disease and fertilizer treatment. Select soil tests are performed annually and mineral soil amendments (Limestone, potassium fertilizer, etc.) are applied if necessary. Before lime applications are made, the soil should be aerated. Nitrogen application of 1#/1000 square feet should be made as necessary in the spring (late April). Because of the proximity of the parks to surface waters, no phosphorous fertilizers are to be applied. Phosphorous-containing fertilizers contribute to eutrophication of water and the growth of aquatic weeds. Turf restoration (overseeding), if necessary, should be carried out with a slicer-seeder during the months of late August through September. If turf is restored, a snow fence is erected to protect the grass. The performance standard is set at less than 2% trash visible with a 0% trash tolerance goal.

Turf Level II is a lower maintenance grass that typically occurs in combination with trees. Without trees it occurs in areas outside of parkland that are viewed but not often walked over or sat upon.

- **Maintenance Standard - Turf Level II: Mowed to height of 4” every 7-12 working days.**

The soil is tested and fertilized as required and some weeds and bare spots are acceptable, but routinely corrected. Less than 5% trash with 0% trash tolerance goal.

Turf Level III is the lowest maintenance grass other than the meadow. Typically, it is not very visible from the paths and parkways. It may be in very dense shade and therefore grow at a slower rate.

- **Maintenance Standard - Turf Level III: Mowed to height of 4.5” every 14-18 working days.**

This turf requires no fertilizer, no irrigation, occasional repair, some weeds are tolerated, and it can be allowed to wear out and grow through rest cycles. Less than 5% trash with 0% trash tolerance goal.

4.8.1.2 Meadows

Meadows with annual and perennial flowering species provide a naturalistic contrast to the other grass areas of the park system.

Meadow Level I encompasses the areas within the park that are designed to have higher grasses, but that are adjacent to heavily trafficked areas or parkways.

- **Maintenance Standard - Meadow Level I: Meadow grass no higher than 2 feet.**

Trash removed weekly; less than 2% trash cover with a 0% trash tolerance goal. Meadow mowed four times per year.

Meadow Level II is adjacent to woodlands and refers to areas that are allowed to grow in a more natural meadow environment to provide wildlife habitat.

- **Maintenance Standard - Meadow Level II: Meadow grass not higher than 2½ feet.**

Trash removed based on inspection, meadow mowed twice per year. Meadow grass shall be cut once in June following spring flowers or early spring to encourage summer flowers. A final cut will be made in the fall to remove past vegetation.

4.8.1.3 Athletic Fields

Athletic fields require a high level of daily maintenance to provide safe playable field surfaces. There is only one maintenance standard for the athletic turf within the Muddy River parks. It is important that athletic fields do not become a visual intrusion on the historic element of the park.

- **Maintenance Standard - Athletic Turf Level I: Mowed to a height of 2 ½ to 3” with zero infield depressions.**

Trash removed daily, infield dragged once/week from April – August, backstops and seating in good repair, fields relined as necessary, turf mowed weekly, irrigated regularly. For more detailed information on field maintenance and management, refer to the Boston Park and Recreation Athletic Field Maintenance Plan.

4.8.2 Planting Areas - Shrub Care

Goal: Rejuvenation of shrub areas and the establishment of regular maintenance appropriate to the species.



Shrub bed in Olmsted Park.

Shrubs and groundcovers provide numerous functions and are a vital part of the park landscape. When properly selected and maintained, they serve as focal points, accents, help control circulation, and provide an aesthetic appearance, complimenting and enhancing the surrounding park landscape. The annual maintenance program for new and established plants depends on the type of plant material and the skill levels of the personnel responsible for the work. Shearing of shrubs is to be discouraged except in the most formal areas such as the rose garden and the war memorial. Shrubs should be pruned with the plant's natural form in mind; plants are not to be sheared into little balls dotting the landscape.

Planting Areas Level I includes formal hedges and shrub beds. These features surround formal spaces within the park such as the rose garden and the war memorial. They have a manicured formal appearance usually reflecting the nature of the space they surround. The shrub species will be kept pruned on a regular basis and in general the maintenance will be of a high level.

- **Maintenance Standard - Planting Areas Level I: Less than 10% weeds and 5% deadwood in bed.**

Shrub beds and small trees are edged and mulched each spring. Shrub beds are maintained and weeded monthly. Shrub beds and small trees are watered as required. Trash removal completed 3 times per week.

Planting Areas Level II includes informal hedges and shrub beds. Typically hedges and shrubs of this type will surround the Victory Gardens and the Riverway Maintenance area. They have a more bushy irregular appearance in keeping with their surroundings and a much lower level of maintenance. These hedges look reasonable if kept untrimmed.

- **Maintenance Standard - Planting Area Level II: Less than 10% weeds and 10% deadwood in bed.**

Shrub beds and small trees are edged and mulched each spring. Shrub beds are maintained and weeded every other month. Shrub beds and small trees are watered as required. Trash removal is completed once per week.

Planting Areas Level III typically abut woodland areas and are more naturalistic areas that serve to provide a visual screen or buffer between intensively used areas and wildlife habitat. Use is typically low level and informal. The shrubs are allowed to achieve their natural form. The shrubs will rarely be pruned and species will be chosen that will flourish in the particular site and light conditions and will grow to the desired height without any pruning or shaping.

- **Maintenance Standard - Planting Area Level III: Less than 10% invasives.**

Shrub beds and small trees are edged and mulched biannually. Shrub beds are maintained and weeded two times per year. Trash removal completed once per month.

4.8.3 Gardens

Gardens Level I refers to the only rose garden in the park located in the Fens. The skills required to undertake this work are of a specialized nature and are probably best allocated to one or two individuals and trained volunteers who are assigned to the area.

- **Maintenance Standard - Gardens Level I: Less than 5% weeds.**

Gardens are maintained on an annual basis at a high level of horticultural care; weeding, irrigation, fertilizing, disease control, disbudding done weekly.

4.8.4 Woodland Management

Goal: Removal of trees that are hazardous, in significant decline, or inappropriate (including exotic invasive species) to the landscape design and intent. Implementation of a regular tree maintenance program that will preserve the health and structural integrity of park trees. All woodland areas and trees will be inspected seasonally and treated according to the integrated pest management requirements.



Pathways and Turf in Olmsted Park.

More than any other landscape element, trees provide the most prominent visual component in the landscape. Tree preservation and management involves the protection of the canopy, trunk and roots.

Trees in public parks are subject to intensive visitor use. Over time this use can have severe impacts. Ongoing public use includes the following:

- Compaction and lack of soil fertility begins to change the soil both physically and chemically.
- Rainwater begins to runoff (causing soil erosion) rather than percolating down through the soil and to the plants' roots.
- Groundcover materials such as turf are lost or damaged.
- Exotic invasives begin to seed in the woodlands (such as Ailanthus, Rhamnus, Phellodendron, Norway Maple, Malus, Euonymus, Berberis, Celastrus, Ampelopsis) and the character of the woodland begins to deteriorate. Native invasives such as Black Cherry and Black Locust also seed and should be removed.
- Native shrubs and native understory trees are lost.
- Older native trees cannot compete for nutrients and water and begin to decline – tops die back.
- Areas become so impacted that users begin to seek other locations.

Park managers must be vigilant to spot these trends early and initiate corrective practices such as liming, fertilization, corrective pruning and keeping walking paths well mulched with composted wood chips. The removal of exotic invasives is an intensive recurring task. Smaller plants can be handpulled. However, the most effective strategy for eradication is cutting and spraying the freshly cut stump with a small quantity of tricopyr. Brush should be chipped and blown into the forest if possible, or in turf areas. Wood chips should be composted in another location.

Age diversity in the canopy layer is a long-term goal. Ideally the trees should be of all ages with every stage present from newly established plants to past maturity.

Woodland Level I areas are characterized by rough grass and shrubs under trees on gently rolling topography. It is a pleasant open area for sitting in, picnicking or walking through. The nature of the topography is critical as the grass must be capable of being mown 3-4 times annually. Walking paths through the long grass can be cut shorter and more often. The actual frequency of mowing depends on the density of the tree canopy and park setting.

- **Maintenance Standard - Woodland Level I: Less than 5% invasives and less than 5% deadwood.**

Trees are inspected and pruned as necessary for health and safety biannually, and thinned out every five years. Trash is collected weekly. Woodland areas are planted 2 years after thinning to enrich natural regeneration. Stumps are removed following tree removals to improve appearance and assist maintenance.

Woodland Level II areas are natural areas and serve to provide a visual screen or buffer to more intensively used areas and habitat for wildlife. Use is typically low and informal. They require a low level of maintenance, but a high level of skill for management and implementation of work. The objective in the forest areas is to sustain a continuous tree cover with the area being regenerated naturally. Both the canopy and understory will be managed on a 10-year cycle. Natural regeneration may, on occasion, be enriched by planting if the desired species do not regenerate naturally.

- ♦ **Maintenance Standard – Woodland Level II: Less than 10% invasives and less than 10% deadwood.**

Trees are safety pruned every five years; hazard trees are removed as required. Trash pickup as required.

4.8.5 Wetlands Management

Goal: To inspect, maintain and replant bordering vegetated wetlands along the Muddy River on an annual basis.



Leverett Pond

Water is a central feature of the Muddy River parks of the Emerald Necklace. Given the importance of water, it is essential that it be kept in good condition, both in the treatment of the edges and in the quality of the water. The water bodies in the Muddy River parks of the Emerald Necklace require ongoing maintenance along the embankments and in the water.

Routine maintenance tasks will include:

- ♦ Trash removal
- ♦ Removal of water-borne vegetation such as duckweed, etc.
- ♦ Removal of invasive vegetation
- ♦ Regular water sampling to monitor water quality

Wetland or embankment plantings have been separated into three levels of maintenance depending upon plant selection, historic landscape design and relationship to pathways. All of the embankment maintenance recommendations include the removal of invasive species such as phragmites, Japanese knotweed and buckthorn. Level I is more rigorous whereas Level III is the least rigorous requiring less frequent, yet still skilled maintenance.

4.8.5.1 Embankment Plantings

- **Maintenance Standard - Embankment Planting Level I: Less than 5% trash, 90% planting density, less than 5% exposed soil and less than 5% weeds and/or invasives.**

Plantings are maintained by properly trained personnel monthly. Invasive species are removed on a monthly basis. Replacement plants are installed seasonally.

- **Maintenance Standard - Embankment Planting Level II: Less than 5% trash, 90% planting density, less than 5% exposed soil, and less than 10% weeds and/or invasives.**

Plantings are maintained by properly trained personnel four times per year. Invasive species are removed on a quarterly basis. Replacement plants are installed seasonally.

- **Maintenance Standard - Embankment Planting Level III: Less than 5% trash, 90% planting density, less than 5% exposed soil, and less than 15% weeds and/or invasives.**

Plantings are maintained by properly trained personnel two times per year. Invasive species are removed on an annual basis.

4.8.5.2 Watercourse (10' zone from embankment edge into water)

Goal: The watercourse is an important visual and flood control element of the Muddy River parks. It is essential that it be kept in good condition, both in the treatment of the edges and in the quality of the water.



The Riverway

Watercourse Level I is intended to keep the watercourse free from obstructions, trash and water-borne vegetation such as duckweed.

- ♦ **Maintenance Standard - Watercourse Level I: Less than 2% trash.**

Trash removed from watercourse weekly. The goal is less than 2% trash.

Watercourse Level II refers to areas of the river that are more difficult to access and have less of an impact on the visual and functional elements of the park.

- ♦ **Maintenance Standard - Watercourse Level II: Less than 5% trash.**

Trash removed from watercourse on a quarterly basis. The goal is less than 5% trash.

4.8.6 Trash Removal

Goal: The park system should be clean and free from trash and litter. Trash receptacles should not be overflowing and litter should be kept to a minimum.



Trash Removal Level I through III have to do with the appearance of the park and sanitary conditions, including litter pick-up and collection of trash from receptacles. Trash Removal Level I is specified for high use areas that generate a significant amount of trash. Trash Removal Level III corresponds to areas that have demonstrated over time the need for less frequent removal of trash.

Maintenance Standard – Trash Removal Level I: Zero overflowing cans.

Minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing/day.

- **Maintenance Standard - Trash Removal Level II: Zero overflowing cans.**

Minimum of once a day, 5 days/week. Use may dictate more frequent cleaning.

- **Maintenance Standard - Trash Removal Level III: Zero overflowing cans.**

Minimum servicing 2 to 3 times/week. Litter barrels should be emptied up to 3 times per week from April through October and weekly during the winter.

4.8.7 Repair and Preservation

The following categories relate to work having to do with the proper functioning and safety of park equipment and facilities, preventative maintenance and repair, such as repair of park lighting, bench repair, park structure maintenance and graffiti removal.

4.8.7.1 Parking Lots and Pathways:



- **Maintenance Standard - Paved Surfaces Level I: Less than 2% in degraded condition.**

Sweeping, cleaning and washing of surfaces done weekly so there is no accumulation of sand, dirt or leaves accumulated.

- **Maintenance Standard - Paved Surfaces Level II: Less than 5% degraded condition.**

Should be cleaned when there is a noticeable accumulation of debris.

- **Maintenance Standard - Path Maintenance: Less than 5% degraded condition.**

Repair stone dust and asphalt paths, including minor repairs, grading and potholing as necessary.

4.8.7.2 Park Furniture Maintenance

Maintenance of park site furnishings includes:

- Bench maintenance – repair, replacement, painting
- Trash cans – emptying, replacement
- Light poles – replace bulbs, painting, realigning
- Drinking Fountains – cleaning, repair, turn on & off
- Graffiti Removal

Regular maintenance of the park's site furnishings is an important task, which is often overlooked or only done on an emergency basis. Keeping park furnishings in good repair makes for a more inviting and usable park.

A uniform set of park furnishings should be developed for the Muddy River parks of the Emerald Necklace including trash cans, benches, lighting standards and drinking fountains. Olmsted designed the park as a whole. Standardized furnishing will reinforce the historic character of the park while adding visual continuity to the park. In addition, maintenance is easier if there are one or two bench styles instead of five or six. Repairs are more likely to be done with “available materials” or not done at all when too many options exist. As much as possible, maintenance practices of park furnishings should be standardized throughout the Muddy River parks of the Emerald Necklace. This will reinforce the sense of one park both visually and managerially.



- **Maintenance Standard – Park Furniture Level I:** Are inspected weekly and routine repairs are done within 3-5 working days.

4.8.7.3 Graffiti Removal

Maintenance standards for Graffiti removal are followed unless they involve a historic structure that requires historic preservation notice or authorization.

- ♦ **Maintenance Standard - Graffiti Removal Level I: Graffiti removed within 24 hours.**
- ♦ **Maintenance Standard - Graffiti Removal Level II: Graffiti removed within 48 hours.**



4.8.7.4 Structures

All buildings and structures within the Emerald Necklace Muddy River parks will be managed and maintained with the goal of preserving the historic authenticity and structural integrity of the buildings. In addition, all buildings and structures will be inspected and their condition will be recorded annually. New work necessary because of changes in use should meet the state building code. However, historic buildings should not be altered solely to make them compliant with the state building code as this could have an adverse affect on the resources. Code related work that may be necessary when historic buildings are converted to a new [public] use should also respect the historic character and meet the Secretary's Standards for Rehabilitation. Alterations for accessibility should be carefully designed to respect both the historic landscape and structures. Work required to stabilize the structures, prevent vandalism and insect or animal damage should be considered a high priority and implemented immediately.

- ♦ **Maintenance Standard** – Structures Level I: Historic structures require very specialized maintenance and sensitive treatments. All historic structures are assumed to be Level I, however the particular problem or situation may necessitate a specific response. Small, routine in-house repairs are done within 3-5 working days. Contracted repairs are assessed within 3-5 working days. Annual maintenance is done yearly and Preservation maintenance is done cyclically according to the Secretary of the Interior's Standards.

Historic preservation to structures shall be completed in accordance with the Secretary of the Interior's standards for the Treatment of Historic Properties, 1995: "The intent of the Standards is to assist the long-term preservation of a structures significance through the preservation of historic materials and features. The Standards pertain to historic buildings of all materials, construction types, sizes, and occupancy and encompass the exterior and

interior of the buildings. They also encompass related landscape features and the building's site and environment, as well as attached, adjacent, or related new construction. To be certified for Federal tax purposes, a rehabilitation project must be determined by the Secretary to be consistent with the historic character of the structure(s), and where applicable, the district in which it is located.”

Standards for Preservation

1. A property will be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property will be protected and, if necessary, stabilized until additional work may be undertaken.
2. The historic character of a property will be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features will be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
6. The existing condition of historic features will be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires repair or limited replacement of a distinctive feature, the new material will match the old in composition, design, color, and texture.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.

The Emerald Necklace Master Plan lists the following structures as part of the Muddy River parks:

Olmsted Park

Kelly Rink (removed)
Cumberland Ave bridge
Ward's Pond footbridge
Willow Pond footbridge

Riverway

- Huntington Avenue Overpass
- Back Bay Maintenance Yard
- Carlton Street Footbridge
- Longwood Bridge and associated staircase
- Chapel Street Bridge and Shelter
- Netherlands Road and Brookline Ave bridges

Back Bay Fens

- Boylston Street Bridge
- Agassiz Bridge
- Fen Bridge
- Stony Brook Gatehouse
- Fens Gatehouse
- Agassiz Road Shelter (Duck House)
- Clemente Field House
- Boston Fire Alarm Headquarters
- World War II Memorial, Vietnam Memorial, Korean Memorial

These structures are discussed further in the existing conditions chapter.

4.9 Equipment

An equipment acquisition and replacement schedule is available in each jurisdiction and will support the increase in staffing and equipment for maintenance. Equipment will be replaced as it wears out and new more effective equipment becomes available.

4.10 Maintenance and Monitoring Schedule

As indicated in the tasks above, the Muddy River parks require a great number of diverse tasks to care for this unique landscape. A maintenance calendar and monitoring checklist (see Appendix A) was created that lists all tasks that need to be completed in each park sector per month. This chart will also be used to monitor the success of each organization in achieving these standards.

Following the Muddy River Restoration project there will be an increased level of maintenance for the newly restored landscape to preserve and protect both the public investment and the legacy of this historic park.

4.11 ETM Maintenance Maps

(See Attached PDF)

4.11 ETM Maintenance Maps

List of Maps

1. **Agency Areas of Responsibility**
2. **Contract Limit Lines**
3. **ETM Sectors**

Levels of Maintenance by Task and Sector Maps

4. **Sector I Hort** – Charlesgate: Planting Areas, Embankment Plantings, Gardens, Watercourse
5. **Sector I Turf** - Charlesgate: Turf, Woodlands, Athletic Fields, Playgrounds
6. **Sector IIA Hort** – Back Bay Fens North: Victory Gardens/ Mother’ Rest: Planting Areas, Embankment Plantings, Gardens, Watercourse
7. **Sector IIA Turf** – Back Bay Fens North: Victory Gardens/ Mother’ Rest: Turf, Woodlands, Athletic Fields, Playgrounds
8. **Sector IIB Hort** – Back Bay Fens Central: Rose Garden/Clemente Field: Planting Areas, Embankment Plantings, Gardens, Watercourse
9. **Sector IIB Turf** – Back Bay Fens Central: Rose Garden/Clemente Field: Turf, Woodlands, Athletic Fields, Playgrounds
10. **Sector IIC Hort** – Back Bay Fens South and Sears Parking Lot: Planting Areas, Embankment Plantings, Gardens, Watercourse
11. **Sector IIC Turf** - Back Bay Fens South and Sears Parking Lot: Turf, Woodlands, Athletic Fields, Playgrounds
12. **Sector III Hort** – Riverway: Planting Areas, Embankment Plantings, Gardens, Watercourse
13. **Sector III Turf** – Riverway: Turf, Woodlands, Athletic Fields, Playgrounds
14. **Sector IVA Hort** – Olmsted Park North: Leverett Pond/Daisy Pond: Planting Areas, Embankment Plantings, Gardens, Watercourse
15. **Sector IVA Turf** - Olmsted Park North: Leverett Pond/Daisy Pond: Turf, Woodlands, Athletic Fields, Playgrounds
16. **Sector IVB Hort** – Olmsted Park South: Wards Pond/Willow Pond/Nicholson Hill: Planting Areas, Embankment Plantings, Gardens, Watercourse

17. **Sector IVB Turf** – Olmsted Park South: Wards Pond/Willow Pond/Nicholson Hill: Turf, Woodlands, Athletic Fields, Playgrounds

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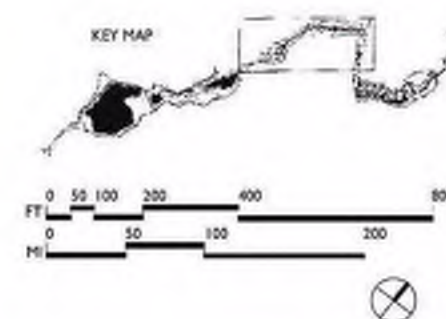
BOSTON PARKS
 BODY OF WATER
 METROPOLITAN DISTRICT
 COMMISSION
 MASSACHUSETTS
 HIGHWAY DEPARTMENT



THE EMERALD NECKLACE - MUDDY RIVER PARKS
 AGENCY AREAS OF RESPONSIBILITY

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- BOSTON PARKS
- BODY OF WATER
- METROPOLITAN DISTRICT COMMISSION
- MASSACHUSETTS HIGHWAY DEPARTMENT
- BROOKLINE
- BOSTON/BROOKLINE TOWN LINE



THE EMERALD NECKLACE - MUDDY RIVER PARKS
 AGENCY AREAS OF RESPONSIBILITY

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- BROOKLINE
- BOSTON/BROOKLINE TOWN LINE



THE EMERALD NECKLACE - MUDDY RIVER PARKS
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- MASSACHUSETTS HIGHWAY DEPARTMENT
- EMERALD NECKLACE-MUDDY RIVER PARKS
- MUDDY RIVER CONTRACT LINE



THE EMERALD NECKLACE - MUDDY RIVER PARKS
 MUDDY RIVER RESTORATION PROJECT CONTRACT LIMIT LINE

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MUDDY RIVER PARKS
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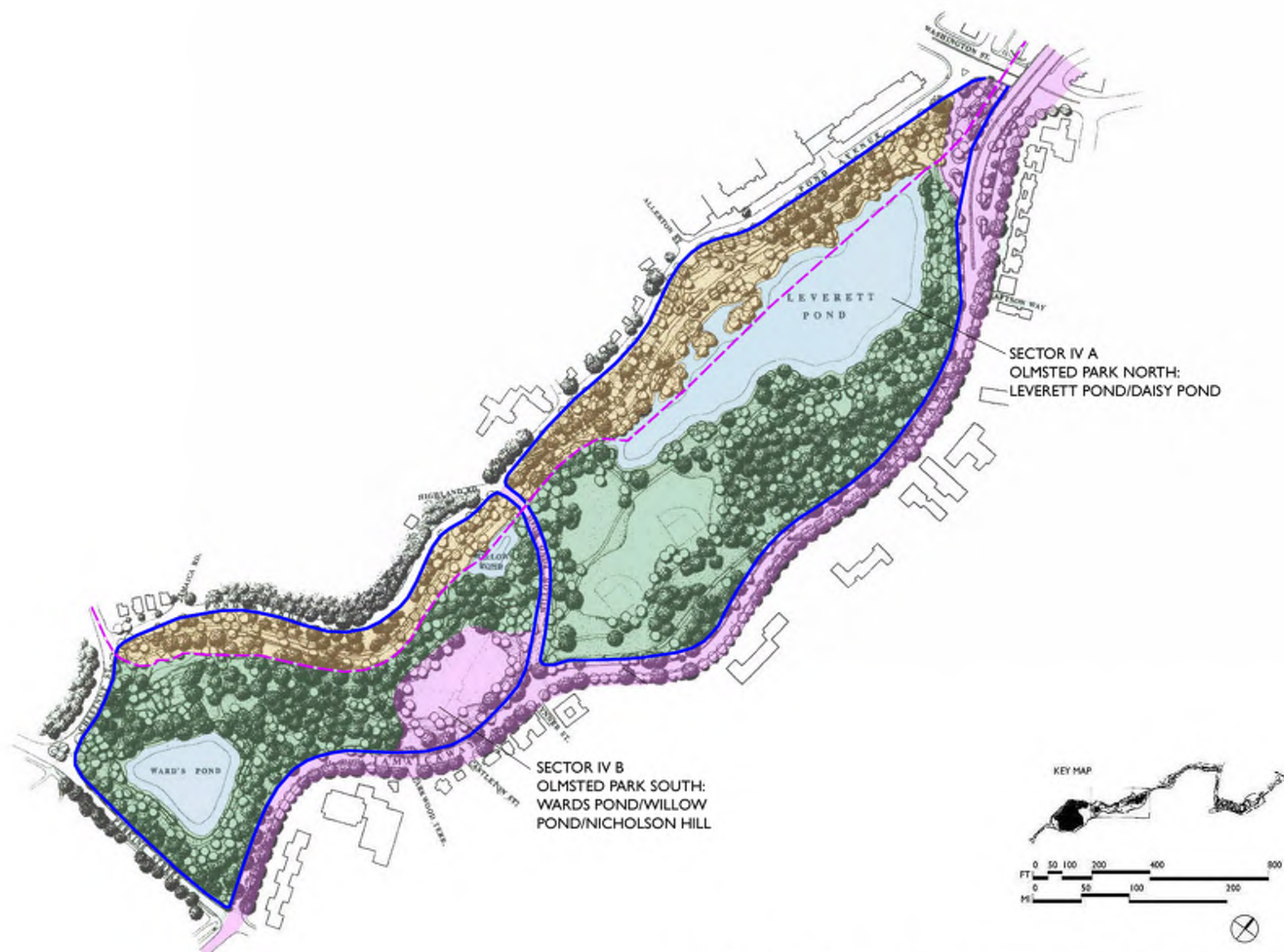
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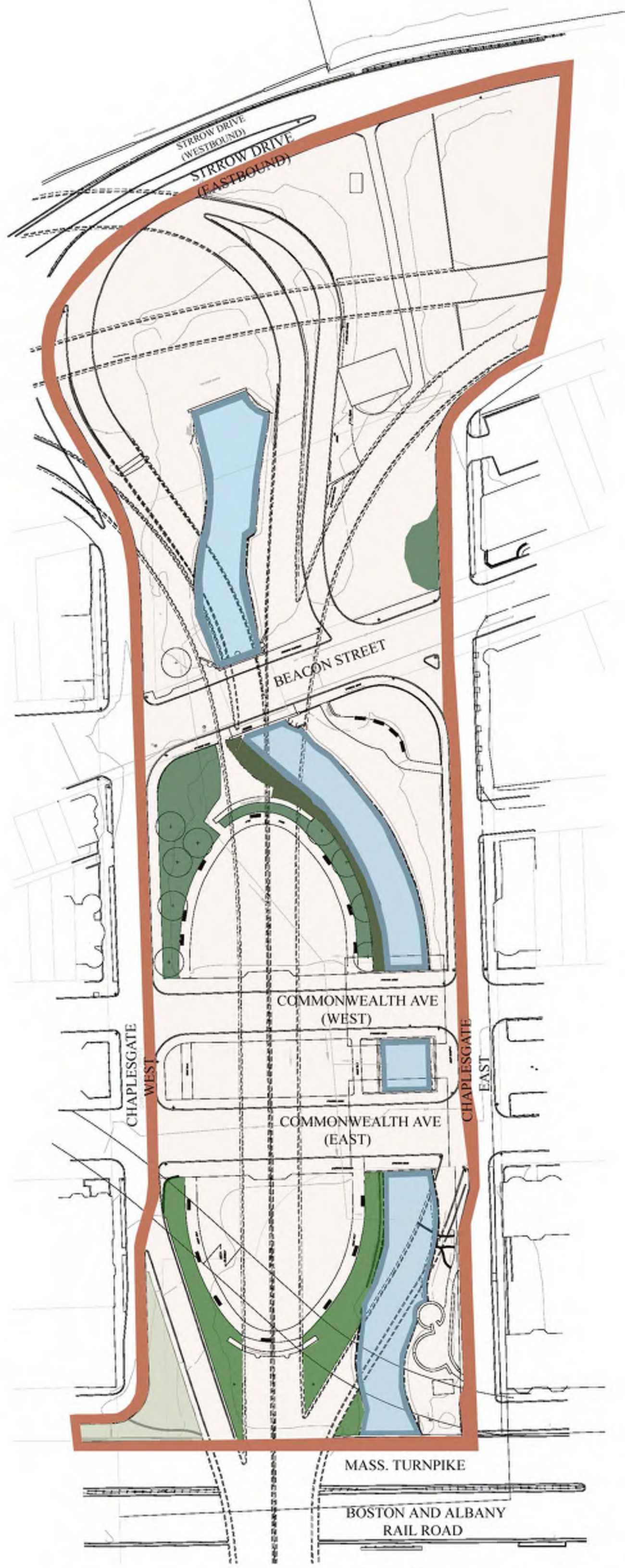
THE EMERALD NECKLACE - MUDDY RIVER PARKS

ETM SECTORS

Emerald Necklace - Muddy River Parks

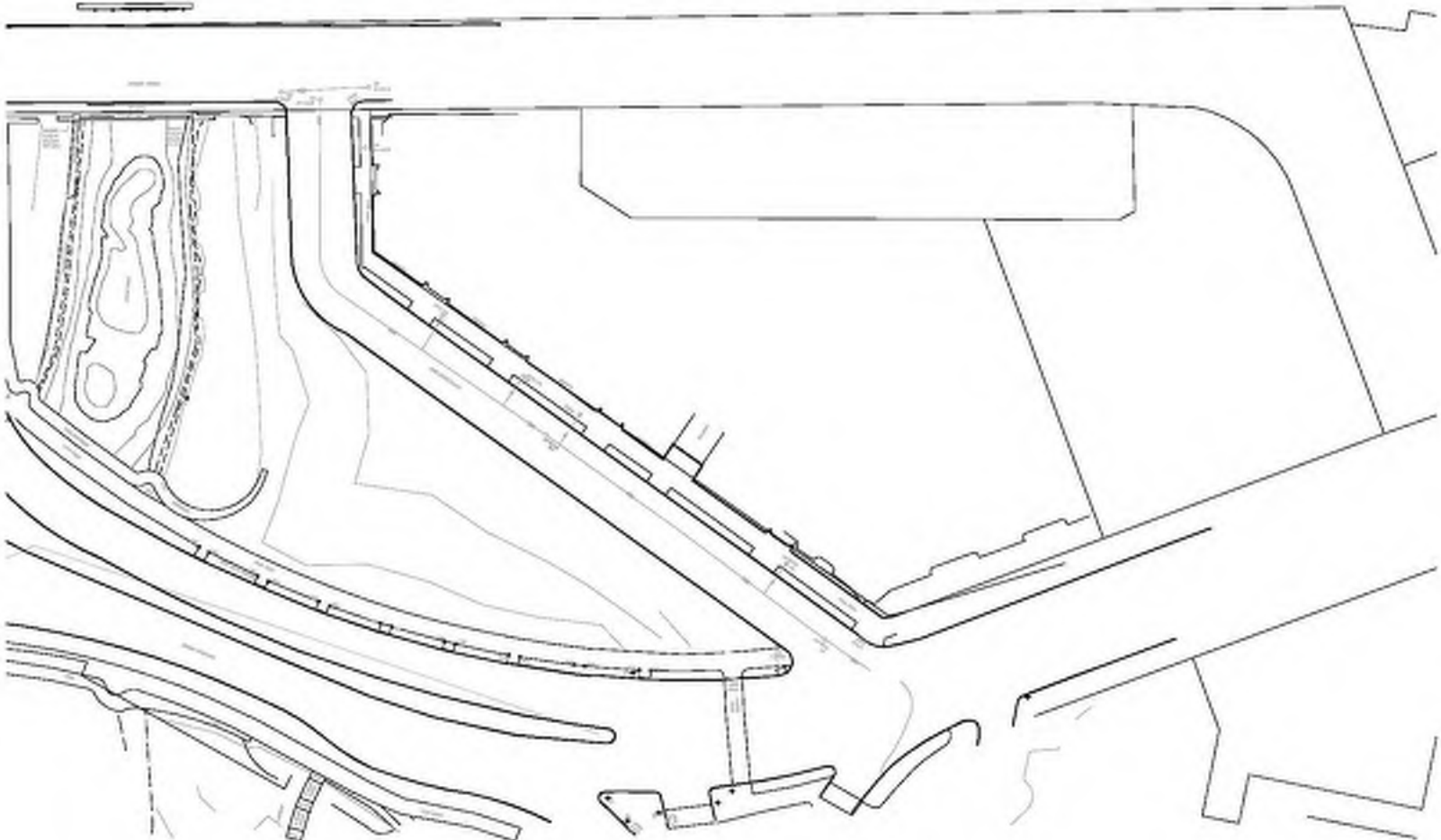
Levels of Maintenance by Task and Sector

Sector: I



Legend:

- Planting Areas - Level 1
- Embankment Plantings - Level 1
- Gardens - Level 1
- Watercourse - Level 1



Emerald Necklace - Muddy River Parks

Levels of Maintenance by Task and Sector

Sector: I



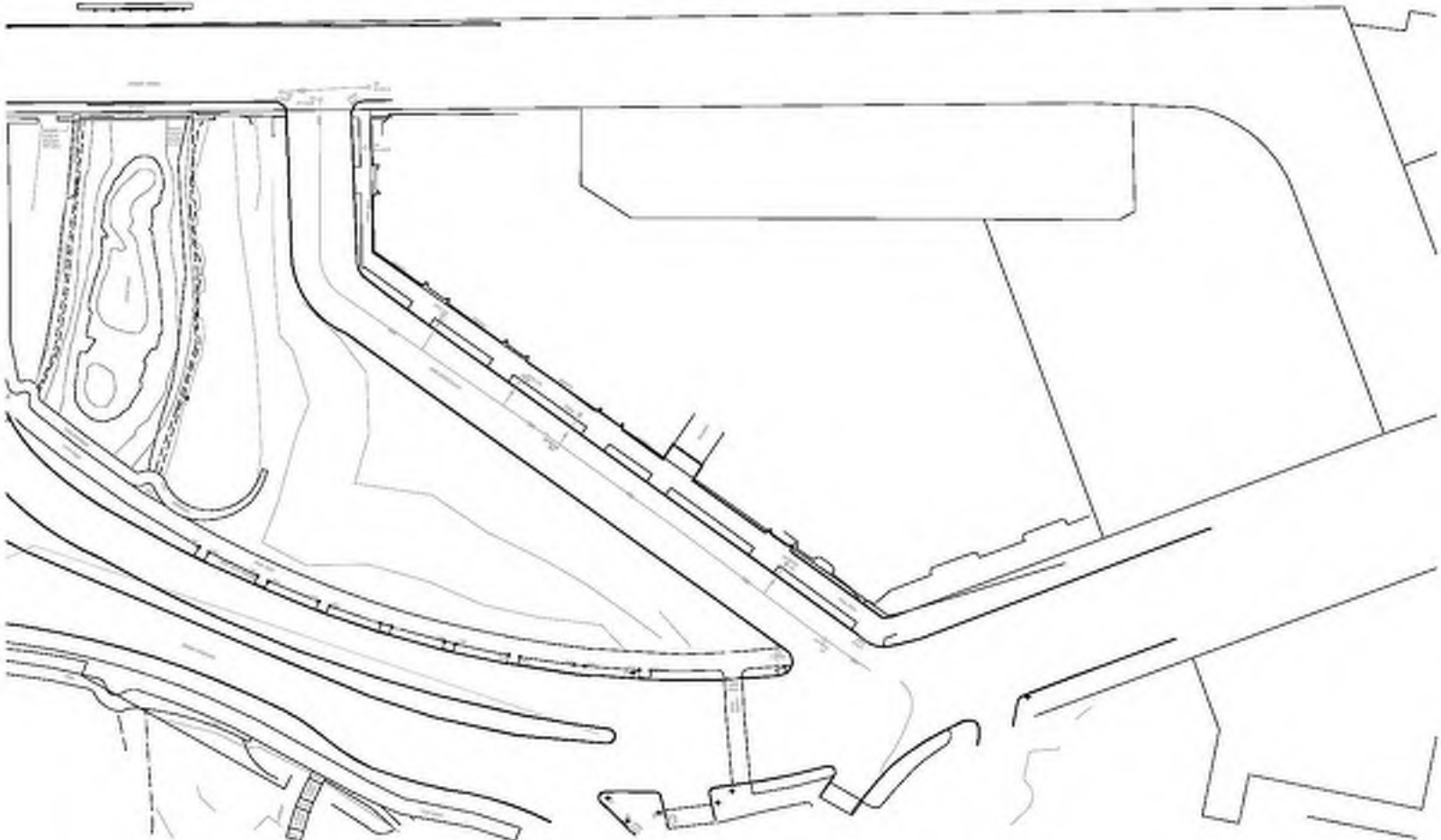
Legend:

Turf:

- Level - 1
- Level - 2
- Level - 3

Woodlands:

- Level - 1
- Level - 2
- Athletic Fields
- Playgrounds



Emerald Necklace - Muddy River Parks

Levels of Maintenance by Task and Sector

Sector: IIA

Legend:

- Planting Areas - Level 1
- Embankment Plantings - Level 1
- Gardens - Level 1
- Watercourse - Level 1



Emerald Necklace - Muddy River Parks

Levels of Maintenance by Task and Sector

Sector: IIA

Legend:

Turf:

- Level - 1
- Level - 2
- Level - 3

Woodlands:

- Level - 1
- Level - 2
- Athletic Fields
- Playgrounds



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: IIB

Legend:

- Planting Areas - Level 1
- Embankment Plantings - Level 1
- Gardens - Level 1
- Watercourse - Level 1



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: IIB

Legend:

Turf:

- Level - 1
- Level - 2
- Level - 3

Woodlands:

- Level - 1
- Level - 2
- Athletic Fields
- Playgrounds



Emerald Necklace - Muddy River Parks

Levels of Maintenance by Task and Sector

Sector: IIC



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: IIC



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: III / Riverway

Legend:

- Planting Areas - Level 1
- Embankment Plantings - Level 1
- Gardens - Level 1
- Watercourse - Level 1



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: III / Riverway

Legend:

- Turf:
- Level - 1
 - Level - 2
 - Level - 3
- Woodlands:
- Level - 1
 - Level - 2
 - Athletic Fields
 - Playgrounds



Emerald Necklace - Muddy River Parks

Levels of Maintenance by Task and Sector

Sector: IVA



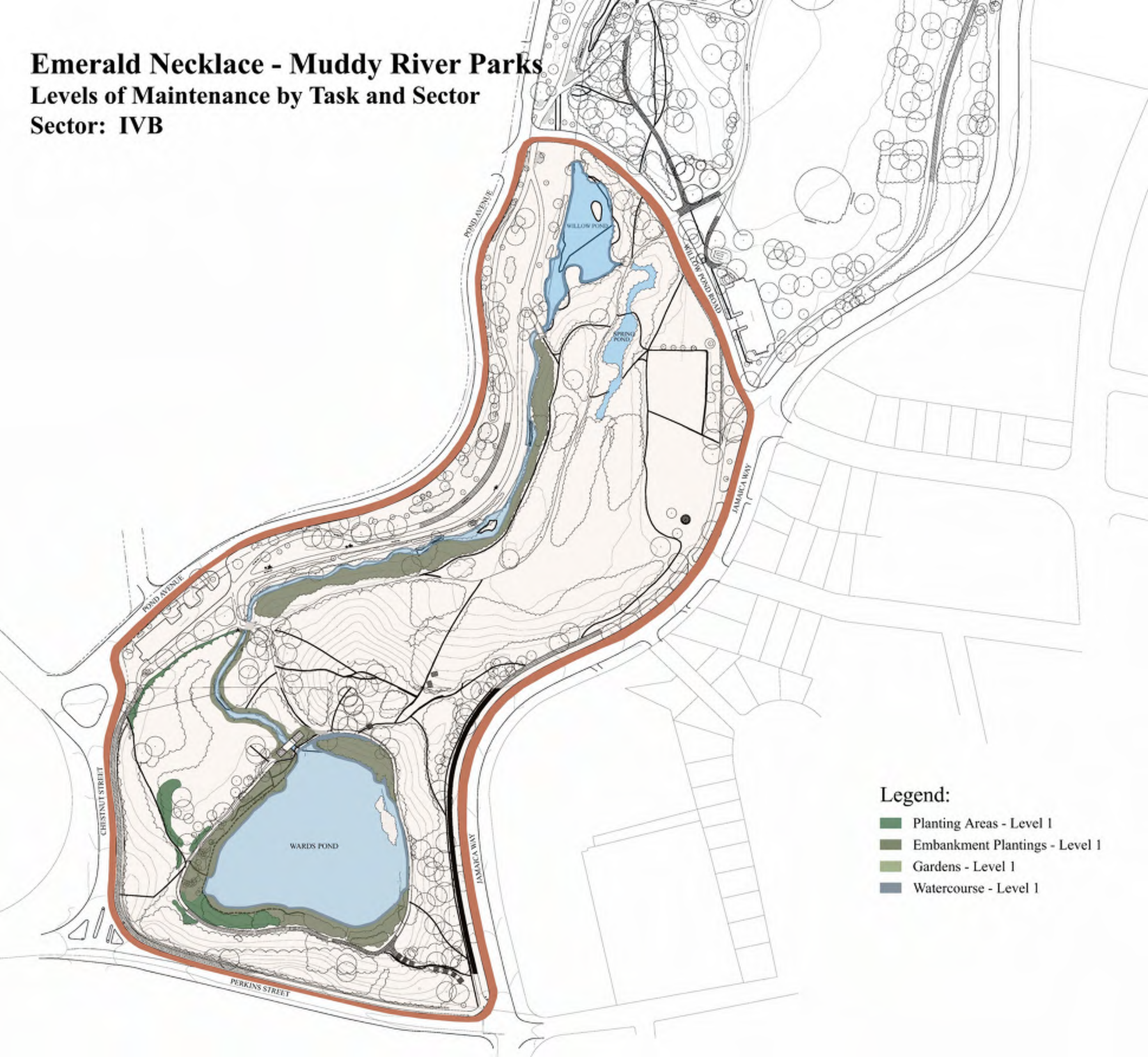
Legend:

- Planting Areas - Level 1
- Embankment Plantings - Level 1
- Gardens - Level 1
- Watercourse - Level 1

Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: IVA



Emerald Necklace - Muddy River Parks
Levels of Maintenance by Task and Sector
Sector: IVB



CHAPTER 5: MANAGEMENT

5.1 Introduction

The objectives and recommendations contained in this chapter are based on the history of the Emerald Necklace Muddy River parks along with the inventory, documentation and analysis of existing conditions, and information gathered from meetings and interviews with park staff, friends of the park and other organizations. This chapter outlines the proposed management structure, in the form of a Muddy River Cabinet, and sets forth management objectives and recommendations that will ensure the successful implementation of this Management and Maintenance Plan.

5.2 Management Objectives

The management objectives described below are structured as follows: objectives for the park as a whole and specific recommendations related to sectors of the Emerald Necklace Muddy River parks.

5.2.1 Park System Management Objectives

In order for the Management and Maintenance Plan for the Muddy River parks to be successful, the owners and managers of the parks must embrace management objectives that recognize the importance of the park as a cultural landscape. In order to accomplish this goal, the following management objectives were established during the Emerald Necklace master planning process:

- Foster greater appreciation of the Emerald Necklace Muddy River parks as a cultural landscape: Significant cultural landscapes demand higher levels of understanding, public awareness and sympathetic treatment than other recreational grounds.
- Respect the value of the natural environment of the parks: Every effort should be made to enhance the natural resources of the parks through a sound management and maintenance program and programming for the open space that respects the environment.
- Foster a new generation of park managers: Historic and cultural properties require a management structure and maintenance staff with specific skills related to preservation maintenance, cultural resource management, horticulture and other related areas. The appointment of Park Administrators and “Horticultural” crews in New York City’s Central Park, Prospect Park and Riverside Drive Park, as well as fields of preservation maintenance and horticulture in the National Park Service, are evidence of emerging trends. More demands are imposed on park administrators to address contemporary needs in historically sensitive ways: for example, to evaluate original planting plans and plant lists in the light of authenticity, public safety, maintenance and cost.
- Strengthen and coordinate management: The success of this plan depends on ongoing coordination of the owners of the Emerald Necklace Muddy River parks, park staff, volunteers and park partners around management and maintenance of the parks as well as the

coordination of capital projects and the maintenance they require. The need for strong cross-jurisdictional communication among management partners, as well as a sound management and maintenance program that will ensure a seamless appearance for the Emerald Necklace Muddy River parks cannot be overemphasized.

- ♦ Institutionalize public/private partnerships: State and municipal government must continue to be responsible for certain park services and improvements. However, as the economic climate of the 1990s and 2000s has shown, the private sector should continue to be encouraged to play an expanded role. This role, however, needs to be clearly defined and directed in ways that benefit the cultural landscape and enhance overall conditions.
- ♦ Be aware of outside impacts on the parks: Parks are subject to external events and are inseparable from the cities, towns or neighborhoods of which they are a part. The Muddy River parks are no exception, and have been continuously affected by events outside, as well as inside their boundaries. These changes can threaten the future of the parks or compromise resources. Park managers should recognize the external threats and pursue strenuous efforts to control them.
- ♦ Establish emphasis of the park as a cultural landscape: The Emerald Necklace Muddy River park system is a special place because of its rich and unique history. The addition of unobtrusive, on-site interpretive signs or other appropriate interpretive methods would help share the park's history with its visitors. Park staff who are familiar with cultural landscape maintenance, particularly horticulturalists, would also help to communicate the importance of the parks as a historic resource and contribute greatly to the long-term preservation of the parks' character-defining vegetation. Management and development of the parks should strive to preserve the known and potentially significant historic features and significant natural resources for future generations. These features should be considered individually and for their contribution to the overall character of the landscape.
- ♦ Respond to contemporary uses: One of the most difficult tasks facing the caretakers of historic parks is to provide access for present and future generations of users, while maintaining the integrity of the historic property. New uses should be considered in relation to the Emerald Necklace's historic integrity and should be accommodated in ways that do not compromise the historic design intent or adversely affect extant resources. Recreational uses should be consistent and sympathetic to the historic character of the property. The siting of new facilities should be carefully scrutinized and generally be discouraged. Mass, scale, form, materials and visual impacts should be carefully considered so that the original design intent, historic character, and integrity of the landscape are not compromised. Park management should strive to offer potential new uses for historic buildings, rather than to encourage new construction.
- ♦ Event programming and control: Several events are held within the Muddy River parks throughout the year. These events bring additional people to the parks, but if not controlled can result in major impacts and also increased maintenance for the park staff. Management, maintenance, and the enforcement of rules and regulations are important to make these events successful for both the public and the park.

- Provide access for all: Special efforts must provide for the young, disabled and elderly. It is crucial that the parks be accessible to all those individuals who wish to visit and engage in appropriate park activities. Physical changes necessary to accommodate disabled visitors should be carefully designed so that they are compatible with the historic character of the property.
- Limit vehicular impacts: Public parks, in general, are subject to assaults from the automobile and other modes of transportation. Any future planning should emphasize limits and restriction to automobiles in the parks, as well as minimizing changes to the parks' edges to accommodate additional parking. The current parking areas in the parks are compatible with their use.
- Expand park programming: A key to the future use, interest and support of the Emerald Necklace Muddy River parks is the expansion of park programs – information, exhibits, tours, events, public relations, and education. Programming reinforces existing constituencies and establishes new ones, but should not accomplish this at the expense of the environment or the historic integrity of the site. Park programming can also reinforce capital outlays, security, park use, advocacy and stewardship. Along with expansions in programming is the need to establish guidelines for use and enforcement of park-related rules.
- Expand horticultural capabilities: The Emerald Necklace Muddy River parks have a unique and significant designed landscape with a large collection of specimen shrubs and trees as well as naturalistic plants requiring subtlety of treatment. These features contribute to both the historic significance and character of the park. They should be monitored, managed and maintained with the necessary technical skills needed to treat individual plant species correctly, as well as to preserve the character of individual features. Without skilled horticultural and arboricultural care, the parks risk the inadvertent loss of significant features, and the gradual decline of historic integrity.

5.2.2 Park Landscape Management Objectives

The management objectives for the park landscape include:

- Preserve, protect and rehabilitate as necessary areas within the park that are unique ecological resources.
- Preserve, protect and rehabilitate the extant features from the appropriate period of significance, while allowing for present day users. Various features within the greater park landscape, such as extant vegetation, buildings and structures and the carriage roads are part of the historic Muddy River landscape and should be retained, preserved and maintained as a character-defining feature.
- Preserve, protect and rehabilitate the extant features from the period of significance, while allowing for intensive use in specific areas: Selected areas within the park, such as the athletic fields and recreation areas, should be maintained in a manner that is in keeping with their intensive use by the community and park visitors.

5.3 Management Issues and Recommendations

There are many recommendations for the Muddy River parks that are not specific to a particular sector of the park system, but are applicable for the parks as a whole. These management recommendations are intended to ensure regulatory compliance throughout the project. The recommendations should also ensure the practice of cultural resource management. Good cultural resource management includes the following considerations:

- 1) Planning for both capital project and normal maintenance take into consideration impacts on cultural resources;
- 2) Consultation with appropriate review bodies, such as the Brookline Preservation Commission, Boston Landmarks Commission or the Massachusetts Historic Commission; and
- 3) In the case of federally funded or regulated projects, compliance with Section 106 of the National Historic Preservation Act must be met.

The recommendations are as follows:

5.3.1 Buildings and Structures

The Emerald Necklace parks were embellished with many special buildings and bridges, most of which survive today. Several buildings, such as the gatehouses at Park Drive and Brookline Avenue, the Fens and Charlesgate had engineering functions. Some bridges, such as Boylston Street, Longwood and Brookline Avenue were imposing structures, while others, such as the pedestrian bridges in the Riverway and Olmsted Park, were intimate in scale, similar to the viewing shelters and overlooks. Overtime, some of these structures have been allowed to deteriorate, even to the point where they are no longer safe to use. This plan seeks to establish work procedures that institutionalize cyclical preservation as opposed to reconstruction or rehabilitation due to neglect.

Park managers should evaluate the significance of historic buildings and guide preservation efforts accordingly. All buildings within the Muddy River parks should be managed and maintained with the goal of preserving the historic authenticity and structural integrity of the buildings. In addition, all buildings and structures in the Muddy River parks should be inspected and their condition recorded annually. New work necessary because of changes in use should meet the state building code. However, historic buildings should not be altered solely to make them compliant with the state building code as this could have an adverse affect on the resources. Code related work that may be necessary when historic buildings are converted to a new use should also respect the historic character and meet the Secretary's Standards for Rehabilitation. All historic buildings not in use should be mothballed properly.

5.3.2 Heritage and Specimen Tree Inventory

The Emerald Necklace illustrates Olmsted's design ideas at the height of his professional career. Master Plan and restoration projects must be faithful to these ideas while recognizing current needs and resources. An accurate inventory of trees and plant material is critical to guiding

decisions for historically appropriate replacement species as some of this material becomes overly mature.

A Heritage and Specimen Tree Inventory has been completed for the Brookline portion of the Riverway. An inventory with maintenance recommendations should be developed and fully implemented for the rest of the Emerald Necklace Muddy River parks. The former MA DEM's Division of Forests and Parks, through its Bureau of Forestry, provided technical assistance and training to municipalities for the identification, evaluation and protection of heritage trees. The newly formed MA Division of Conservation and Recreation should be consulted to see if the agency is available to assist in the identification and management of trees in the Emerald Necklace in two ways:

- Development of an inventory form for heritage and specimen trees for the Muddy River parks
- Training of park staff and volunteers in the identification, documentation and assessment of heritage and specimen trees

The final product of the Heritage Tree Inventory should comprise a complete documentation of heritage and specimen trees in the parks and along the parkways, including their condition, location and a prioritized list of recommended treatment actions. Treatment of the trees could range from pruning and cabling work to removal and replacement in kind and should be incorporated into maintenance planning for the parks. The park system needs a systematic forestry management program with a mission to increase forest health and ecological diversity.

In addition to heritage trees, a complete inventory of historic character-defining vegetation, particularly specimen shrub collections would provide critical information to enhance management and maintenance. It would aid in determining maintenance needs, and in solutions related to long-term replacement.

5.3.3 Interpretation and Signage

The Muddy River parks need signs to guide today's traffic and activities. This signage must be compatible with the landscape, structures and furnishings. Research has revealed historic prototypes compatible with these park settings. Signage in other urban historic parks has been evaluated. Proper attention to message and design will allow necessary signs to enhance rather than detract from the parks' natural quality.

The Emerald Necklace Muddy River parks have always been recognized for their immense interpretive and educational potential, with opportunities for visitors to enjoy the historic and natural landscape. However, a comprehensive interpretive program has not been developed, and the sensitive landscape has presented a challenge in creating a system of wayside panels, signage or other interpretive features. Because of this, interpretive features are very limited.

Signage along the trails and landscape of the Emerald Necklace Muddy River parks falls into two categories: Wayfinding signage and Interpretive signage.

Interpretive: A full interpretive plan for the historic landscape of the Muddy River parks should be developed. In general, signage within the parks should be designed to be unobtrusive and compatible with the park landscape. In this historic area the quantity of signs should be limited to prevent visual clutter. Interpretive signage at other locations should be consistent with the overall interpretive strategy for the parks.

Wayfinding: Wayfinding signage is designed to guide park visitors through the parks. The existing wayfinding system includes signage indicating pedestrian and bike paths, and parking areas. Wayfinding signage should be clear and readily identifiable.

5.3.4 Program and Events Calendar

A key to the future use, interest and support of the Emerald Necklace is the expansion of park programs – information, exhibits, events, tours, public relations and education. Programming is also the key to rehabilitating currently unused buildings. Park programming reinforces capital outlays, security, park use, advocacy and stewardship.

Many public events and programs are held in the Emerald Necklace Muddy River parks each year, particularly in the warmer months. Programs and more specifically events should be reviewed for their impacts to the parks. In order to accommodate the work needed to host these events, park staff should develop a method for tracking the schedule and tasks for these activities. This could be done through an internal calendar of events and programs, that indicates the necessary preparation time for the events, including set up and break down, and the number of persons needed to staff the events. Post event maintenance should also be included.

The continuation of the Park Ranger program is essential to build strategic partnerships between the police, rangers, parks staff and the public. Both the perception and the actuality of greater security are important to all park users. Park Rangers provide a friendly and informative uniformed presence and also foster a greater public understanding of the historic and environmental value of the Emerald Necklace parks. A complete program of information, exhibitions, tours, public relations and educational programs is to be developed as the Master Plan improvements are carried out.

5.3.5 Wetlands

All ponds, rivers streams, land under water, bordering vegetated wetlands and floodplains within the Muddy River parks are subject to the Massachusetts Wetlands Protection Act. Appropriate permits must be sought from either the Boston or Brookline Conservation Commission for activities that may alter the resource areas.

Continuing management and monitoring of all the parks' wetlands is ecologically important. With the exception of maintenance, any work that occurs within the wetland areas of the Muddy River parks will need to seek the regulatory authority of the Wetlands Protection Act and the Massachusetts Endangered Species Act (MESA). Management of the wetlands, especially in the ecological restoration efforts, requires local Conservation Commission permits, and an official filing with the regional Department of Environmental Protection office.

5.3.6 Roads and Trails

The Emerald Necklace Master Plan illustrates that there is no common standard of paving materials, no vocabulary of furnishings, and no policy governing the alignment of walks or the placement of lights, benches, trash receptacles, drinking fountains, or signs throughout the park. The various paving surfaces and furnishings in the parks represent a patchwork of intermittent, unrelated efforts to arrest the decline of the Muddy River parks and their related parkways. Park paths have been neglected, particularly in Olmsted Park and the Riverway. This lack of coordination is evidence of the larger problem of fragmented management and absence of a consistent overall maintenance approach.

Several primary and secondary carriage roads and footpaths exist within the Emerald Necklace Muddy River parks. These roads should be treated according to the park system-wide recommendations above, which propose a comprehensive maintenance, management and rehabilitation program for pathways and roads. A thorough mapping and investigation of the trail system in the Emerald Necklace Muddy River parks should be undertaken. First, the location of the trails should be more accurately mapped. A more accurate mapping of the trails would be beneficial to both the park managers and visitors.

Secondly, during the inventory process an assessment of trail condition and hierarchy could be performed to determine which trails are in need of erosion control measures. All trails that need erosion control measures should be treated. Finally, it is recommended that the parks take a more active control over the use of particular trails.

Brookline has installed paved pathways with rolled aggregate in lieu of the historically designed gravel or stone dust paths. This decision was made to avoid the impact of erosion from the paths into water bodies and to facilitate maintenance of the park.

5.3.7 Circulation

There are numerous interruptions between the parks in the Emerald Necklace system, particularly at the Route 9 and Bowker Interchanges. At Olmsted Park, access to Ward's Pond from Perkins Street is restricted to the east side. At the Riverway, access to the park from the east sides of Longwood Bridge is inadequate, and the decorative iron Carlton Street Bridge (over the MBTA tracks) is closed. Park continuity, circulation and access were an essential part of the historic parks' success.

The existing visitor parking lots, two at Pond Avenue, one at Daisy Field and one at Clemente Field, should remain the only parking lots for visitors to the parks. Any consideration of additional visitor parking, even for event overflow parking, should undergo a thorough study and investigation related to impacts to the historic landscape, visual impacts and safety/traffic.

5.3.8 Park Furnishings

Many recent repairs to park features have been undertaken in materials that are easy to vandalize or susceptible to early deterioration under current use conditions. All materials considered for

use in the parks should be evaluated for their long-term durability and ease of maintenance. Usually these considerations will result in materials that are consistent with the originals: stone curbs are better than concrete, cast iron is better than anodized aluminum for light standards. The hardest woods that can be acquired without negatively affecting the earth's rain forests should be used for benches and shelters. Metal and/or wood are the materials of choice for signage.

Throughout the Muddy River parks, curbs, stairs, walks and fences need repair or replacement. Many of the smaller park "destinations" (such as shelters and overlooks) which gave meaning and pleasure to movement through the park are missing.

Most park furnishings have also suffered over time. Older walk lights have not been maintained, particularly in the more remote sections. They have been replaced by newer models that are in various conditions. Floodlights have appeared at Daisy Field in Olmsted Park and at Clemente Field in the Fens. Historic benches are almost totally absent; concrete and wooden benches, as well as the "Emerald Necklace" design have been introduced. Many of these are in need of repair. Circulation and furnishings were an essential part of the historic parks' success and they are critical for the greatest enjoyment of today's users.

5.3.9 Goose Control

Invasive wildlife can have a negative impact on plant material, park appearance and user enjoyment. The Canada Goose has become problematic throughout the eastern United States and is having a negative impact on the Muddy River parks. Each spring Boston and Brookline make an effort to reduce the number of geese infesting our parks and detention ponds. The Canada Goose is protected by state and federal laws, which protect all species of migratory birds. Both Boston and Brookline hold a federal Egg and Nest Depredation Permit, which allow the parks agencies to affect a maximum of 30-50 goose nests. Each nest usually contains between 6 and 12 eggs. Many other land management agencies throughout the region are also involved with egg and nest depredation.

Signage stating that feeding of waterfowl permitted is not permitted and educational campaigns for the public are critical. In addition, significant changes are also being made in landscape design to reduce goose populations. This regional approach to population control is an appropriate start for dealing with problem goose populations, but assistance on a state or federal level may ultimately be necessary to effectively control the Canada Goose population.

5.3.10 Recreation

There is a need to improve recreational opportunities for walking, cycling, jogging, boating, picnicking, theatre, free-play in open areas, softball, sledding, sitting, watching, nature study, contemplation, and other forms of scenic enjoyment in the Muddy River parks.

While the parks were originally intended for a variety of activities, opportunities for many historic pleasures have disappeared. While many activities currently take place, conditions for multiple uses could be made better by separating competing uses, providing a fully functional circulation system and rehabilitating the key structures.

5.3.10 Pest Management

An integrated pest management program for the Muddy River parks is not a "no pesticides ever" program. It utilizes integrated pest management techniques that emphasize physical, biological and cultural pest controls, alternatives to pesticides and least toxic pesticides. The use of pesticides is suggested as a last resort and only when necessary. All areas of the Muddy River parks, including the Victory Gardens, should utilize integrated pest management.

There are more than one million insect species, but less than one percent of those are considered pests. The other 99 percent play a crucial role in our food chain and many are indispensable. Flying insects such as bees and butterflies pollinate fruits and vegetables. Burrowing insects aerate soil and assist in the decomposition of organic material by returning nutrients to the soil. Insects also serve an important role as a food source for birds, fish, other animals and some plants.

IPM utilizes regular monitoring to determine if and when treatments are needed. It employs physical, mechanical, cultural, biological and educational tactics to keep pest numbers low enough to prevent damage and annoyance through least toxic and economical methods of pest management. IPM utilizes information on the pest and environmental conditions as well as the best available pest management methods.

Unlike most commercial pesticide applications, IPM treatments are not made on a schedule. Treatments are made only if monitoring indicates that pests will cause an unacceptable amount of economic, medical or aesthetic damage. Treatments are timed to be made when they will be most destructive to the pest and least disruptive to natural pest control methods.

5.4 Management Recommendations for Maintenance

The level and consistency of maintenance in the Emerald Necklace Muddy River parks must be determined, planned and funded. The most important issues that could arise in the future include:

- Sufficient maintenance funds: The owners of the parks should establish an operational budget that includes sufficient maintenance and ensures funding continuity in the future. Historically, many public parks have not received adequate maintenance funding. Often, when funding seems in place, subsequent budget cuts necessitate reductions in maintenance efforts. Typically, government appropriations and grants are available for specific capital improvements, but not for operating costs such as maintenance. For this reason, public agencies must work hard to establish and protect an appropriate maintenance budget.
- Protection of funds to hire and train staff and to maintain equipment: The owners of the parks should establish positions and a budget necessary to hire and train both skilled and sensitive horticulturalists and professional arborists needed to maintain the historic landscape, as well as additional maintenance staff to care for the parks, including seasonal workers. This recommendation should become a priority for the park. In addition, funds should be available to maintain and upgrade equipment.

- Protection of the historic integrity of the Emerald Necklace Muddy River parks: The level and quality of maintenance has a great effect on the condition and integrity of the park landscape. Inadequate or inappropriate maintenance, for example, can result in the loss of the character-defining features, design intent, and diminished integrity. Loss of integrity can, in turn, result in the loss of historic significance. The maintenance program must recognize the historic significance of the parks and should be tailored to preserve the landscape and its components.
- Planning and Design of Capital Improvements: Capital improvements within the Emerald Necklace Muddy River parks need to be designed with long-term preservation and maintenance in mind. Some special focal areas such as Allerton Overlook may benefit from irrigation.
- Update the maintenance and management plan: The maintenance and management program should be reviewed and updated on a regular basis, in order to incorporate new information and experience in maintenance gained over time related to the ongoing process of parks restoration. In addition, new technical advances, methodologies, and equipment should also be incorporated into the parks management. We recommend that the program be reviewed and revised as necessary, but at least every five years.

5.5 Recommended Studies and Plans to Follow the Management and Maintenance Plan

Upon the adoption of this Management and Maintenance Plan, the parks' owners should pursue additional plans that build on the findings and recommendations in this document.

Recommendations for additional work include:

- Habitat plan
- Interpretive plan
- Signage plan
- Invasive Species Task Force plan
- Plant Inventory, including Heritage Tree Inventory
- Long-term preservation and use plan for buildings and structures

5.6 Management Structure and Coordination

Upon completion of the Phase I Muddy River Project, nearly \$100 million will have been spent from federal, state, local and private sources on the Emerald Necklace's waterparks and related landscapes. In order to ensure that this level of investment is protected and preserved, a management structure for the project area and adjacent parks must be in place.

The Muddy River project area is a portion of the Emerald Necklace, the core of Boston, Brookline and the Commonwealth's historic park system consisting of a series of linear parks of nearly 1,000 acres. The Muddy River project area runs from Wards Pond down through Charlesgate at the Charles River and form the border between Boston and Brookline. The City of Boston, through the Boston Park and Recreation Department, is responsible for maintaining 117 acres of parkland within and adjacent to the project area.

The Town of Brookline, through the Park and Open Space Division, is responsible for maintaining 32 acres of parkland within and adjacent to the project area. The Commonwealth of Massachusetts owns the Charlesgate section of the Back Bay Fens and is responsible for the care, custody and control of the parkways and parkland located 25 feet in from the curb, an area totaling approximately 35 acres within the project area. The total Muddy River project area and adjacent parklands is 184 acres or 18 percent of the entire Emerald Necklace.

There is no single organization that manages the Muddy River park system with the result that Boston, Brookline and the Commonwealth of Massachusetts have developed, over time, differences with regard to: management objectives, maintenance standards, maintenance resources, capital improvement projects, work methods, priorities and technical solutions. In practice these manifest themselves as different user activities, path surfacing, landscape treatment, maintenance priorities and use of voluntary labor.

The Muddy River Maintenance and Management Plan identifies areas that are in need of a higher level of care that is coordinated, consistent and seamless. Park users should be able to enjoy the parks without distraction, moving freely and with pleasure from city to town, path to bridge, woodland to overlook, experiencing the very diversity of spaces Olmsted envisioned. One way to foster that change is to create a new management structure for the park system in conjunction with an increased commitment to management, maintenance and restoration.

In order to correct the unbalanced maintenance of the Muddy River parks, the project partners are proposing the creation of a Muddy River Project Management Cabinet [The Cabinet]. The proposed Management Cabinet addresses the lack of a single authority with overall responsibility for the management and maintenance of the Muddy River parks. The Cabinet Management Structure holds each of the property owners accountable for maintenance and management responsibilities within their jurisdiction, however, it provides a framework for management oversight, public input, partner cooperation, and a forum to review, plan and improve park maintenance. The proposed Muddy River Project Management Cabinet includes: the Boston Parks Department, Brookline Parks and Open Space Division, the Massachusetts Division of Recreation and Conservation, the Emerald Necklace Conservancy, and the Muddy River Maintenance and Management Oversight Committee.

5.6.1 Muddy River Project Management Cabinet

The Muddy River Project Management Cabinet [The Cabinet] will facilitate uniform maintenance and management of the entire Muddy River park system. The project partners have completed a draft Memorandum of Agreement [MOA] that will define the roles and responsibilities of each partner and park maintenance commitments. A Committee comprised of Boston, Brookline, the State, the ENC and the MMOC have worked collaboratively to identify issues to be included in the MOA, a draft of which is included in Appendix E. The Cabinet members providing public funds will also be signatories to a Memorandum of Understanding (MOU) describing the estimate funding to be provided by the parties.

This structure has been selected because it is consistent with MEPA's direction to protect the public investment in the project and consistent with the proponents' responsibilities for

management of municipally owned resources. The agencies responsible for park maintenance want to provide a seamless approach to maintenance not only within the Muddy River parks but also through the city and town's parks as a whole. Retaining authority over the park areas in any management structure allows this to happen. However, in order to protect the massive public investment in this project, the city, town, and state have agreed to work cooperatively and to integrate a Management Cabinet dedicated to protecting Olmsted's Emerald Necklace parks into on-going management.

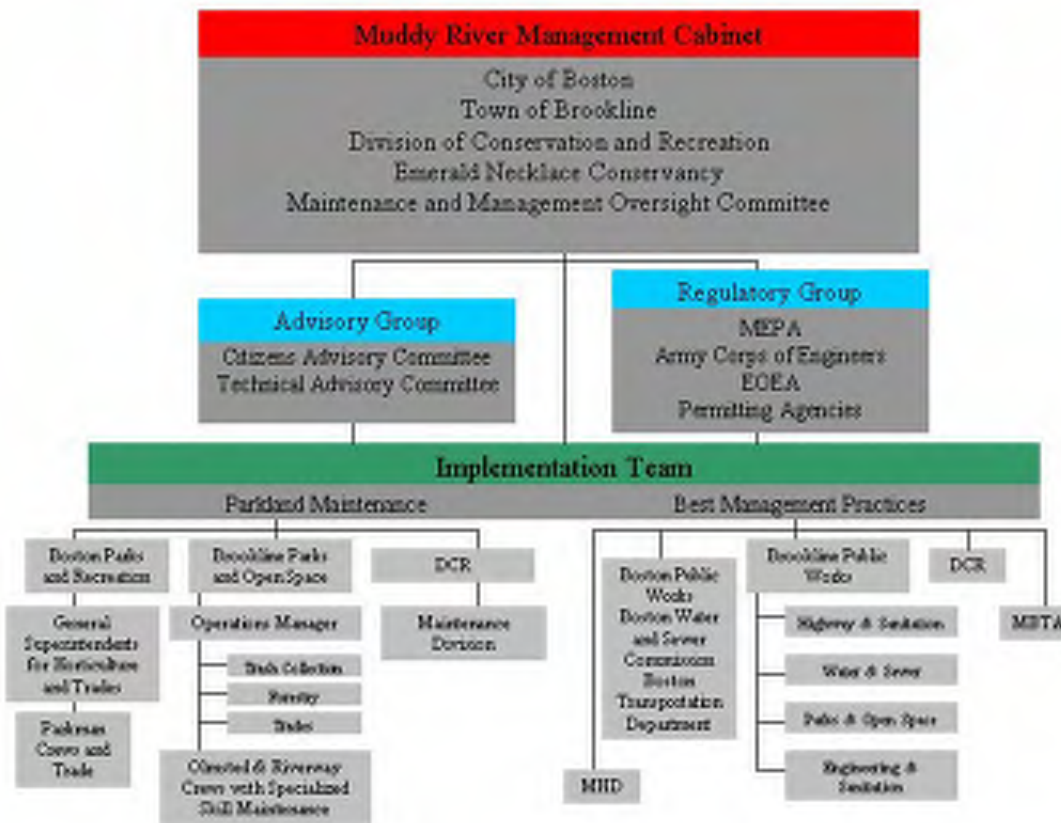
The Management Cabinet is designed to ensure that the goals of the Muddy River project are met through cooperative management, accountability and appropriate responsibility for long-term maintenance activities. The Management Cabinet will:

- Ensure unified quality performance standards for restoration and maintenance;
- Ensure seamless care of the parks system;
- Ensure effective completion of the Muddy River Restoration project;
- Protect and upkeep the significant public investment in the Emerald Necklace park system;
- Develop a workforce with the specialized expertise necessary to meet the unified quality standards to care for the historic and natural landscapes;
- Provide a safe, comfortable and positive environment for the public throughout the system for all seasons;
- Ensure sufficient and consistent public funding streams;
- Help to leverage significant private resources in support of the park system.

In the Cabinet a senior representative of each entity (Boston, Brookline and DCR) with parkland responsibilities would meet with the ENC and the MMOC to set policy and goals for work inside the project area, parkland (park maintenance) and for work outside the parkland (principally BMPs). These representatives would be Commissioner/Director/Chair level at each entity and have the ability to commit resources or influence the commitment of resources to the management and maintenance effort. Consistent with MEPA's Final Record of Decision, Boston, Brookline, and DCR will continue to manage the resources under their control, with the flexibility they need to make day-to-day decisions and implement long-term management and operational policies.

An Implementation Team consisting of the staff within the City, Town and DCR would support the Management Cabinet. The Implementation Team would be those actually conducting the maintenance and management of parkland and waterway resources.

Figure 5.1 Muddy River Management Cabinet



5.6.2 Roles and Responsibilities of the Cabinet Members

Roles and responsibilities will be based upon MOA, a draft of which is included in Appendix E.

5.6.3 Implementation

5.6.3.1 Implementation Team – Parkland Maintenance

Parkland maintenance falls under the responsibility of the Boston Parks Department, Brookline Parks and Open Space Division and the DCR. These agencies provide dedicated work crews for specific areas to ensure continuity in carrying out maintenance activities.

The Boston Parks Department’s property maintenance division is under the direct oversight and management of the General Superintendents for Horticulture and Trades. Under the Superintendents’ direction are the regional park crew, horticultural crew and crew foremen for the Muddy River area, to be supplemented by additional workers having specialized skills in woodlands and wetlands maintenance.

Brookline Parks and Open Space property maintenance is under the direct oversight and management of the Operations Manager. Under the Operations Manager are maintenance crews -

including general landscape maintenance, forestry, trades, and litter removal crews - dedicated to the Olmsted and Riverway area.

DCR property is under the overall management of the Deputy Commissioner of Operations who supervises maintenance crews and crew foremen for the Muddy River area.

Collectively, the Boston Parks General Superintendent, Brookline Operations Manager, and DCR Deputy Commissioner of Operations represent the maintenance managers and Implementation Team for each entity under the Muddy River Project Cabinet. They would also meet to work on implementing the goals and policies set out by the partnership. Horticulturists, arborists and crew maintenance supervisors will work with maintenance managers to advise on setting policy and meeting goals.

5.6.3.2 Implementation Team - Best Management Practices

Improvements outside the parkland areas are principally BMPs that will be owned or conducted by several parties such as the Boston Public Works Department, BWSC, DCR, the Town of Brookline and the Brookline Department of Public Works, the Massachusetts Turnpike Authority (MTA), and the Massachusetts Highway Department (MHD). The goal for outside parkland work is that signatories to the MOA will meet their maintenance and implementation commitments and work to coordinate their activities through the Management Cabinet. As new BMPs come online, the management group and each entity will reach a consensus to establish maintenance procedures and the entity will report results so the Cabinet can complete the Annual Update Report for MEPA.

5.6.4 Meetings and Review Sessions

A regular schedule of the Muddy River Project Cabinet meetings between the ENC, the MMOC, Boston, Brookline and the DCR will be developed. The schedule of the meetings and reviews would be the subject of the MOA and generally include:

- Planning and policy meetings several times a year with staff at the Commissioner/Director/Chair level from the Cabinet. These would review on-going parks maintenance, progress to date and establish goals, programs and priorities for succeeding years.
- Prepare and review the Annual Update Report for MEPA and reporting to the CAC and TAC.
- Coordination meetings between Operations Managers, General Superintendents and Deputy Commissioner of Operations to coordinate maintenance activities and standards between park maintenance sections.
- Establishment of any public meetings, public information and other activities to update the general public on the progress of the Muddy River Restoration Project, Emerald Necklace parks maintenance and the like.
- Budget review to meet commitments

5.7 Guidelines for Maintenance and Monitoring Procedures

The importance of monitoring of natural and cultural resources in the Emerald Necklace Muddy River parks cannot be overemphasized. In a popular park system like the Emerald Necklace, an ongoing program to monitor resources allows park staff to proactively manage the parks and to adapt or revise maintenance practices before resources suffer from too much use or deteriorate beyond repair. Park owners should develop a monitoring program to regularly assess the condition of park resources, including critical character-defining features associated with the historic landscape as well as natural resources, such as important habitats, wildlife and wetlands.

Ideally, a field inspection/monitoring program for the park landscape would accomplish two goals. First, it would provide a method for regularly assessing the condition and health of the park's features, to determine when/if intervention is required in advance of drastic measures such as replacement. Without a regular monitoring system in place, it is difficult to track changes from year to year. The following parameters are recommended for field inspections:

- Monitor conditions during the appropriate time and frequency throughout the year(s);
- Monitor changes in health due to decay, pests, diseases, environmental or cultural problems, including vandalism or inappropriate maintenance practices;
- Identify external threats such as visitor use, construction, air quality etc.;
- Diagnose conditions in the field when possible, or note that further diagnosis is needed;
- Describe what level or threshold of damage is acceptable and when action is necessary; and
- Describe the work required to treat the condition, or know where to get more information.

In some instances, specialists may be required to assess particular field conditions. This may be true for some features such as wetlands, and to identify the presence and effects of specific diseases and pests. In addition to regular monitoring, the park would benefit from some specific assessments, such as after unplanned storms or drought. The form of the field inspection could be written notes, photographs, annotated plans, specimen samples, drawings or correspondence. Regardless, electronic records should be retained as part of the maintenance documentation for the parks. Suggested fields for the inspection include:

- Inspected by and date;
- List the feature name and field identification number (if developed);
- Identify the type of feature and criteria for inspection (i.e. What to look for);
- Describe the inspection results;
- Provide comments related to condition, size, stabilization and/or repair work needed;
- Identify if further diagnosis is needed;
- Describe physical work needed (note critical work when needed); and
- Note if the feature is threatened or deteriorating.

Second, a record-keeping system could be used to track work accomplished or major changes in condition. This includes changes in the health, form or condition of the feature, as well as major work performed such as removal, replacement, propagation, or any other activities. At a

minimum, maintenance staff should retain receipts, notes, or other documentation related to maintenance activities so a long-term record exists related to overall site management. This serves an invaluable tool to ensure both consistent and appropriate maintenance practices, particularly when staff changes occur.

5.8 Guidelines for Training and Volunteers

Volunteers play a major role in the maintenance of urban parks. They lead nature walks, supervise playgrounds, participate in park-wide clean-ups, adopt flower plots and help with miscellaneous chores in park offices through out the country. The benefits resulting from successful volunteer programs in parks have ranged from encouraging community “ownership” and increasing the use of parks to identifying and nurturing future community leaders and park donors.

In the Emerald Necklace, volunteers can be used to help with tasks such as controlling invasive species, repainting benches and light posts, graffiti removal, weeding and general parks clean up. Volunteers can be managed through organizations such as the Charles River Conservancy, who has a Volunteer Stewardship Program or the Emerald Necklace Conservancy, who runs a “Volunteers for the Necklace” Program. Volunteers can contact these conservancies directly to get involved in volunteering.

Volunteering provides opportunities for park users to learn more about the natural environment of their parks. Volunteers see their overall purpose as protecting and preserving nature, restoring part of natural landscape to its original condition, and helping nature survive the invasion of weeds and human interference. Managers of volunteer programs need to carefully consider the size of an initial project, and build a program that addresses ecological needs and considers providing demonstration sites for public observations.

Effective programs are built around good planning, background research, community involvement, student participation, training, and long term monitoring. Restoration leaders need to provide clear directions and specific tasks to keep everyone actively engaged. Volunteers need to know they are an essential part of the solution. By providing training to volunteers, they go away with a better understanding of the project, the long-term goals, and how their efforts are incorporated into the long-range plans for a restoration program. People who volunteer are proud to share their experience with others in the community.

5.9 Role of Regulatory Agencies and Committees

All the members of the Cabinet are represented on the MMOC. The proponents and ENC sit on the Technical Advisory Committee. The ENC also has a seat on the Citizens’ Advisory Committee. Each of these committees has a distinct role, and each will inform how the partners make day-to-day decisions and implement long-term management and operational policies.

For the purposes of inclusion and cooperation, the Regulatory Agencies will be addressed as a Regulatory Group. The Group will consist of the Executive Office of Environmental Affairs (EOEA), the Massachusetts Environmental Policy Act (MEPA) Unit within EOEA, the

Department of Environmental Protection (DEP), Massachusetts Historical Commission (MHC) and other permitting agencies such as the City of Boston and Town of Brookline Conservation Commissions and historical commissions. The active participants of the regulatory group may vary by construction contract depending on the permits and approvals applicable to each construction contract. The federal, state, and local regulatory agencies are expected to carry out their responsibilities within each one's current management and administrative framework under their own regulations, policies, and procedures. The regulatory group is responsible for ensuring compliance with applicable regulatory programs including the MEPA process, required permitting, and fulfillment of Section 61 Findings.

In addition, three committees were created during the regulatory process: the Citizens Advisory Committee, the Technical Advisory Committee and the Muddy River Maintenance and Management Oversight Committee.

5.9.1 Citizens Advisory Committee

The CAC, whose members represent a diverse range of backgrounds, experience, and affiliation, provides public input on the full range of environmental issues both to the proponents, as they prepare MEPA submittals, and to the EOE, as it reviews the submissions. The CAC was established by EOE to serve as advisors to the Secretary on the project. Following the submittal of the FEIR, the CAC will receive annual updates from the project proponents regarding the status of the Muddy River improvements. Beyond the annual updates, the CAC can remain active and informed by holding four seats on the MMOC, which will last through the duration of the project plus five years.

5.9.2 Technical Advisory Committee

The TAC is comprised of members having considerable technical knowledge in all areas of importance to the project, principally federal, state and local agencies with regulatory authority. The TAC is the forum for addressing detailed technical issues on project permitting, design, and implementation. The TAC would provide technical support to the Management Cabinet and Project Implementation Team.

5.9.3 Muddy River Maintenance and Management Oversight Committee

The Muddy River Restoration Project Maintenance and Management Oversight Committee (MMOC) is an independent oversight body, established by the Secretary of the Executive Office of Environmental Affairs, for the Muddy River Restoration Project.

In order to ensure full protection of the significant public investment in the Project, and to serve as an innovative collaborative model for similar cross-jurisdictional projects, the MMOC: a) provides ongoing independent evaluation of the Project, including management and maintenance; b) facilitates close coordination and cooperation among Project partners; and c) serves as the formal vehicle for public participation in all aspects of the Project, including its long-term management.

The roles and responsibilities of the MMOC are:

- To ensure outstanding stewardship of the resource by serving as a vital, independent and outspoken ‘watchdog.’
- To participate in the development and ongoing evaluation of performance standards for construction, BMPs and maintenance.
- To identify benchmarks to evaluate Project progress.
- To provide independent review of the Project, including the Participants’ conformance to Project Goals.
- To monitor and evaluate compliance with the provisions of federal, state, and local permits and approvals (including section 61 findings).
- To monitor and evaluate compliance with the MOA, the MOU, and other multi-party contractual obligations to be developed, and with the 1999 MOA and 1999 MOU so long as they remain in effect.
- To promote close coordination of activities among the Project Participants and other relevant public agencies, and where necessary participate effectively in dispute resolution.
- To promote representation of a broad public constituency on the MMOC.
- To provide a conduit for public access to the Project.

5.10 Former Agreements and Partnerships

The Secretary’s Certificate encourages the proponents to amend the 1999 MOU to include the DCR (formerly MDC) as part of the management of the project and to be included in the maintenance of the project area.

There are actually two agreements concerning the Muddy River project that have been executed. A Memorandum of Agreement (MOA) was signed June 8, 1999 between the City of Boston and the Town of Brookline that detailed the financial and management terms for conducting work on the Muddy River project. (See Appendix E.) The Agreement identified the responsibilities for Boston and Brookline in contracting for services and sharing information on the project. There was no specific definition of the level of funding required by either party or source of other funds.

The second agreement was the November 1999 Memorandum of Understanding (MOU) containing the responsibilities for funding and administering the Muddy River Restoration Project. In summary, the MOU identified the City of Boston through its Parks Department as the project manager of Phase I of the project including Charlesgate. The City would receive and disburse funds for the project in cooperation with other participating agencies. The MOU indicated that about \$7.1 million was necessary to complete the planning, design and permitting of Phase 1 of the Project and the planning, design, permitting and construction of Charlesgate. A specific breakdown of the sources of funding was included. The proponents agreed to accept responsibility for costs of maintaining and managing the project including implementation of BMPs once Phase I is complete.

**Appendix A: MAINTENANCE CALENDAR & MONITORING CHECKLIST
FOR THE MUDDY RIVER PARKS OF THE EMERALD NECKLACE MUDDY
RIVER RESTORATION PROJECT**

Maintenance Calendar and Monitoring Checklist

JANUARY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Playgrounds Level I	<ul style="list-style-type: none"> ▪ Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. ▪ Remove trash daily from playground area ▪ Snow removal as necessary 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	

Maintenance Calendar and Monitoring Checklist

JANUARY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Athletic Fields Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
		▪ Maintain signs indicating that playing fields are closed for the season.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Back Bay Fens South and Sears Parking Lot	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Riverway	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	

Maintenance Calendar and Monitoring Checklist

JANUARY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Woodlands Level I	▪ Pick up litter and trash weekly	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	
	Woodlands Level I	▪ Pick up litter and trash weekly	
	Athletic Fields Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. ▪ Maintain signs indicating that playing fields are closed for the season.	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

JANUARY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Woodlands Level I	▪ Pick up litter and trash weekly	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

FEBRUARY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Playgrounds Level I	<ul style="list-style-type: none"> ▪ Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. ▪ Remove trash daily from playground area ▪ Snow removal as necessary 	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	

Maintenance Calendar and Monitoring Checklist

FEBRUARY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level I	<ul style="list-style-type: none"> ▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. ▪ Maintain signs indicating that playing fields are closed for the season. 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Shovel and remove snow as needed 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Shovel and remove snow as needed 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Riverway	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Inspect and prune out dead, broken or diseased branches. ▪ Prune to improve or maintain structural form and stability. ▪ Control invasive vines competing with trees and shrubs. ▪ Pick up litter and trash weekly 	

Maintenance Calendar and Monitoring Checklist

FEBRUARY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	
	Woodlands Level I	▪ Inspect and prune out dead, broken or diseased branches. ▪ Prune to improve or maintain structural form and stability. ▪ Control invasive vines competing with trees and shrubs. ▪ Pick up litter and trash weekly	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Athletic Fields Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. ▪ Maintain signs indicating that playing fields are closed for the season.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

FEBRUARY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Inspect and prune out dead, broken or diseased branches. ▪ Prune to improve or maintain structural form and stability. ▪ Control invasive vines competing with trees and shrubs. ▪ Pick up litter and trash weekly 	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Pruning as needed 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Shovel and remove snow as needed 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Turf Level II	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Pruning as needed 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Shovel and remove snow as needed 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Remove trash daily from playground area Snow removal as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	Remove matted leaf and debris from lawns and open space areas.	
	Turf Level II	Remove matted leaf and debris from lawns and open space areas.	
	Athletic Fields Level I	Remove matted leaf and debris from lawns and open space areas.	
	Planting Areas Level I	<ul style="list-style-type: none"> Conduct an inspection of shrubs. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control. Remove dead or damaged shrubs from plant beds. Note all locations for future replacements. Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees. Clean plant beds of all debris and top dress areas with pine bark mulch. Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Conduct an inspection of shrubs. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control. Remove dead or damaged shrubs from plant beds. Note all locations for future replacements. Clean plant beds of all debris and top dress areas with pine bark mulch. Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees. 	
	Embankment Plantings Level I	Pruning as needed	
	Watercourse Level I	The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Shovel and remove snow as needed	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Pruning as needed 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Shovel and remove snow as needed 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Riverway	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> Conduct an inspection of trees with the arborist. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control. Start scheduled dormant pruning program in order to improve and maintain the trees structural form and stability prior to bud break. Dormant pruning should be completed by mid-March. Inspect trees for insects, apply dormany oil if approved and applicable for insects observed. Start scheduled trees and stump removal. Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees. Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Turf Level II	<ul style="list-style-type: none"> Remove matted leaf and debris from lawns and open space areas. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Conduct an inspection of shrubs. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control. Remove dead or damaged shrubs from plant beds. Note all locations for future replacements. 	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Planting Areas Level I	▪ Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees.	
		▪ Clean plant beds of all debris and top dress areas with pine bark mulch.	
		▪ Trash removal completed three times per week	
	Embankment Plantings Level I	▪ Pruning as needed	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Woodlands Level I	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
		▪ Shovel and remove snow as needed	
		▪ Conduct an inspection of trees with the arborist. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control.	
		▪ Start scheduled dormant pruning program in order to improve and maintain the trees structural form and stability prior to bud break. Dormant pruning should be completed by mid-March.	
		▪ Inspect trees for insects, apply dormany oil if approved and applicable for insects observed.	
		▪ Start scheduled trees and stump removal.	
	Turf Level I	▪ Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees.	
		▪ Pick up litter and trash weekly	
	Turf Level II	▪ Remove matted leaf and debris from lawns and open space areas.	
	Athletic Fields Level I	▪ Remove matted leaf and debris from lawns and open space areas.	
	Planting Areas Level I	▪ Remove matted leaf and debris from lawns and open space areas.	
		▪ Conduct an inspection of shrubs. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control.	
		▪ Remove dead or damaged shrubs from plant beds. Note all locations for future replacements.	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Planting Areas Level I	▪ Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees.	
		▪ Clean plant beds of all debris and top dress areas with pine bark mulch.	
		▪ Trash removal completed three times per week	
	Embankment Plantings Level I	▪ Pruning as needed	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Woodlands Level I	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
		▪ Shovel and remove snow as needed	
		▪ Conduct an inspection of trees with the arborist. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control.	
		▪ Start scheduled dormant pruning program in order to improve and maintain the trees structural form and stability prior to bud break. Dormant pruning should be completed by mid-March.	
		▪ Inspect trees for insects, apply dormany oil if approved and applicable for insects observed.	
		▪ Start scheduled trees and stump removal.	
	Turf Level I	▪ Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees.	
		▪ Pick up litter and trash weekly	
	Turf Level II	▪ Remove matted leaf and debris from lawns and open space areas.	
	Planting Areas Level I	▪ Remove matted leaf and debris from lawns and open space areas.	
		▪ Conduct an inspection of shrubs. Inspect for broken limbs and branches from storm damage. Inspect shrubs for insect and disease problems. The spring inspection will assist in scheduling pruning and pest control.	
		▪ Remove dead or damaged shrubs from plant beds. Note all locations for future replacements.	

Maintenance Calendar and Monitoring Checklist

MARCH - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Planting Areas Level I	▪ Leave wood mulch and other winter protection systems in place until the weather is above 45-50 degrees.	
		▪ Clean plant beds of all debris and top dress areas with pine bark mulch.	
		▪ Trash removal completed three times per week	
	Embankment Plantings Level I	▪ Pruning as needed	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis. Install replacement plants as necessary. 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Should be cleaned when there is a noticeable accumulation of debris. 	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Turf Level II	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Turf Level III	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis. Install replacement plants as necessary. 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Should be cleaned when there is a noticeable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Playgrounds Level I	<ul style="list-style-type: none"> Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials. Remove trash daily from playground area Paved surfaces are swept daily. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Turf Level II	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Review all athletic field surface conditions for winter damage, hazardous or unsafe conditions Weather permitting, fields can be lined for spring sports Inspect fencing for winter damage Review irrigation systems for winter damage, notify Water Department for scheduling repairs Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove winter mulch and debris from beds Edge beds and remove excess material Top dress beds with mulch Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Remove winter mulch and debris from beds Edge beds and remove excess material Top dress beds with mulch 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis. Install replacement plants as necessary. 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Should be cleaned when there is a noticeable accumulation of debris.	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Back Bay Fens South and Sears Parking Lot	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Rake and dethatch turf areas affected by snow molds or other winter damage.	
		▪ Start core aerating and mat dragging schedule.	
		▪ If there are problem areas, conduct soil test to establish base condition.	
	Embankment Plantings Level I	▪ Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis.	
		▪ Install replacement plants as necessary.	
	Watercourse Level I	▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
Riverway	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Woodlands Level I	▪ Pick up litter and trash weekly	
		▪ Start scheduled tree replacements and proposed tree installations according to standard specifications and details.	
		▪ Review with arborist and schedule pruning of trees infected last year by anthracnose, cankers and galls before new growth begins.	
		▪ Prune out dead or damaged branches of trees.	
		▪ Fertilize trees as determined by soil analysis.	
		▪ Remove stakes and guy wires installed on replacement trees planted last spring.	
		▪ Remove winter protection systems once weather temperature reliably rises above 45-50 degrees.	

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Woodlands Level I	<ul style="list-style-type: none"> Provide mulch in a two-foot diameter around the base of all new trees and trees planted the previous year. Consult with the arborist about applying dormant oil to trees with a history of aphid, scale or spider mite infestations ie. Hemlocks, beeches, honeylocust and elm. 	
	Turf Level I	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Turf Level II	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove winter mulch and debris from beds Edge beds and remove excess material Top dress beds with mulch Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis. Install replacement plants as necessary. 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Should be cleaned when there is a noticeable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Pick up litter and trash weekly Start scheduled tree replacements and proposed tree installations according to standard specifications and details. Review with arborist and schedule pruning of trees infected last year by anthracnose, cankers and galls before new growth begins. Prune out dead or damaged branches of trees. Fertilize trees as determined by soil analysis. 	

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Woodlands Level I	<ul style="list-style-type: none"> Remove stakes and guy wires installed on replacement trees planted last spring. Remove winter protection systems once weather temperature reliably rises above 45-50 degrees. Provide mulch in a two-foot diameter around the base of all new trees and trees planted the previous year. Consult with the arborist about applying dormant oil to trees with a history of aphid, scale or spider mite infestations ie. Hemlocks, beeches, honeylocust and elm. 	
	Turf Level I	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Turf Level II	<ul style="list-style-type: none"> Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Review all athletic field surface conditions for winter damage, hazardous or unsafe conditions Weather permitting, fields can be lined for spring sports Inspect fencing for winter damage Review irrigation systems for winter damage, notify Water Department for scheduling repairs Rake and dethatch turf areas affected by snow molds or other winter damage. Start core aerating and mat dragging schedule. If there are problem areas, conduct soil test to establish base condition. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove winter mulch and debris from beds Edge beds and remove excess material Top dress beds with mulch Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis. Install replacement plants as necessary. 	
	Watercourse Level I	<ul style="list-style-type: none"> The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris. 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Should be cleaned when there is a noticeable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	

APRIL - GENERAL TASKS

APRIL - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Structures Level I	<ul style="list-style-type: none">▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none">▪ Keep all roads and paths clear of debris▪ Remove fallen trees immediately	
	Woodlands Level I	<ul style="list-style-type: none">▪ Pick up litter and trash weekly▪ Start scheduled tree replacements and proposed tree installations according to standard specifications and details.▪ Review with arborist and schedule pruning of trees infected last year by anthracnose, cankers and galls before new growth begins.▪ Prune out dead or damaged branches of trees.▪ Fertilize trees as determined by soil analysis.▪ Remove stakes and guy wires installed on replacement teres planted last spring.▪ Remove winter protection systems once weather temperature reliably rises above 45-50 degrees.▪ Provide mulch in a two-foot diameter around the base of all new trees and trees planted the previous year.▪ Consult with the arborist about applying dormant oil to trees with a history of aphid, scale or spider mite infestations ie. Hemlocks, beeches, honeylocust and elm.	
	Turf Level I	<ul style="list-style-type: none">▪ Rake and dethatch turf areas affected by snow molds or other winter damage.▪ Start core aerating and mat dragging schedule.▪ If there are problem areas, conduct soil test to establish base condition.	
	Turf Level II	<ul style="list-style-type: none">▪ Rake and dethatch turf areas affected by snow molds or other winter damage.▪ Start core aerating and mat dragging schedule.▪ If there are problem areas, conduct soil test to establish base condition.	
Planting Areas Level I	<ul style="list-style-type: none">▪ Remove winter mulch and debris from beds▪ Edge beds and remove excess material▪ Top dress beds with mulch▪ Trash removal completed three times per week		
Embankment Plantings Level I	<ul style="list-style-type: none">▪ Plantings are maintained by properly trained personnel. Mulching and pruning as needed. Invasives removed on a monthly basis.▪ Install replacement plants as necessary.		
Watercourse Level I	<ul style="list-style-type: none">▪ The watercourse is inspected weekly for trash and/or debris. A small boat is used as necessary to access the watercourse and remove debris.		
Trash Removal Level I	<ul style="list-style-type: none">▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.		

Maintenance Calendar and Monitoring Checklist

APRIL - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Paved Surfaces Level II	▪ Should be cleaned when there is a noticeable accumulation of debris.	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

May - GENERAL TASKS

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Apply a complete (N-P-K) fertilizer to all turf areas	
		▪ Based on soil tests apply lime to turf areas at the recommended amounts	
		▪ Mow on a 5-7 day schedule. Cutting height shall be 3".	
		▪ Apply approved weed and insect control products according to manufacturers' recommendations	
		▪ Water newly seeded areas daily to maintain even surface moisture	
		▪ Core aerate and mat drag scheduled turf areas	
		▪ Overseed all irrigated athletic fields and turf areas having bare spots	
		▪ Dethatch turf areas	
		▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
▪ Invasive removal completed by trained personnel on a monthly basis			
Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Apply a complete (N-P-K) fertilizer to all turf areas	
		▪ Based on soil tests apply lime to turf areas at the recommended amounts	
		▪ Mow on a 5-7 day schedule. Cutting height shall be 3".	
		▪ Apply approved weed and insect control products according to manufacturers' recommendations	
		▪ Water newly seeded areas daily to maintain even surface moisture	
		▪ Core aerate and mat drag scheduled turf areas	
		▪ Overseed all irrigated athletic fields and turf areas having bare spots	
		▪ Dethatch turf areas	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Turf Level I	<ul style="list-style-type: none"> Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level II	<ul style="list-style-type: none"> Fertilizer if necessary Based on soil tests apply lime to turf areas at the recommended amounts Mow on a 7-12 day schedule. Cutting height shall be 4". Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable. Water newly seeded areas daily to maintain even surface moisture Core aerate and mat drag scheduled turf areas Dethatch turf areas Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level III	<ul style="list-style-type: none"> Mow on a 14-18 day schedule. Cutting height shall be 4.5". 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials. Remove trash daily from playground area Paved surfaces are swept daily. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Apply a complete (N-P-K) fertilizer to all turf areas Based on soil tests apply lime to turf areas at the recommended amounts Mow on a 5-7 day schedule. Cutting height shall be 3". Apply approved weed and insect control products according to manufacturers' recommendations 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level I	<ul style="list-style-type: none"> Water newly seeded areas daily to maintain even surface moisture Core aerate and mat drag scheduled turf areas Overseed all irrigated athletic fields and turf areas having bare spots Dethatch turf areas Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level II	<ul style="list-style-type: none"> Fertilizer if necessary Based on soil tests apply lime to turf areas at the recommended amounts Mow on a 7-12 day schedule. Cutting height shall be 4". Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable. Water newly seeded areas daily to maintain even surface moisture Core aerate and mat drag scheduled turf areas Dethatch turf areas Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Review all athletic field surface conditions for winter damage, hazardous or unsafe conditions Weather permitting, fields can be lined for spring sports Inspect fencing for winter damage Review irrigation systems for winter damage, notify Water Department for scheduling repairs Apply a complete (N-P-K) fertilizer to all turf areas Based on soil tests apply lime to turf areas at the recommended amounts Mow on a 5-7 day schedule. Cutting height shall be 2 to 2.5 " Apply approved weed and insect control products according to manufacturers' recommendations Water newly seeded areas daily to maintain even surface moisture Core aerate and mat drag scheduled turf areas Overseed all irrigated athletic fields and turf areas having bare spots Dethatch turf areas Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Planting Areas Level I	<ul style="list-style-type: none"> Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch. Fertilize new shrubs as determined by soil analysis Review shrubs on site with arborist to determine the best method of pruning flowering and non-flowering shrubs Remove dead shrubs, note their locations and schedule replacements Deadhead fading blossoms 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Planting Areas Level I	<ul style="list-style-type: none"> Remove spring bulbs in mid-May or after passing Add additional screened loam, lime and slow release 10-6-4 fertilizer Water daily in the morning Trash removal completed 3 times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch. Fertilize as determined by soil analysis Deadhead fading blossoms Remove spring bulbs in mid-May or after passing Add additional screened loam, lime and slow release 10-6-4 fertilizer Water daily in the morning 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Plant storm related replacement trees Maintain mulch 2-foot diameter mulch beds around new and existing trees 	
	Woodlands Level I	<ul style="list-style-type: none"> Fertilize trees as determined by soil analysis Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Apply a complete (N-P-K) fertilizer to all turf areas Based on soil tests apply lime to turf areas at the recommended amounts Mow on a 5-7 day schedule. Cutting height shall be 3". Apply approved weed and insect control products according to manufacturers' recommendations Water newly seeded areas daily to maintain even surface moisture 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Turf Level I	<ul style="list-style-type: none"> ▪ Core aerate and mat drag scheduled turf areas ▪ Overseed all irrigated athletic fields and turf areas having bare spots ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Fertilizer if necessary ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 7-12 day schedule. Cutting height shall be 4". ▪ Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable. ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch. ▪ Fertilize new shrubs as determined by soil analysis ▪ Review shrubs on site with arborist to determine the best method of pruning flowering and non-flowering shrubs ▪ Remove dead shrubs, note their locations and schedule replacements ▪ Deadhead fading blossoms ▪ Remove spring bulbs in mid-May or after passing ▪ Add additional screened loam, lime and slow release 10-6-4 fertilizer ▪ Water daily in the morning ▪ Trash removal completed 3 times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Plant storm related replacement trees ▪ Maintain mulch 2-foot diameter mulch beds around new and existing trees ▪ Fertilize trees as determined by soil analysis ▪ Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Apply a complete (N-P-K) fertilizer to all turf areas ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 5-7 day schedule. Cutting height shall be 3". ▪ Apply approved weed and insect control products according to manufacturers' recommendations ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Overseed all irrigated athletic fields and turf areas having bare spots ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Fertilizer if necessary ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 7-12 day schedule. Cutting height shall be 4". ▪ Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable. ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Review all athletic field surface conditions for winter damage, hazardous or unsafe conditions ▪ Weather permitting, fields can be lined for spring sports ▪ Inspect fencing for winter damage ▪ Review irrigation systems for winter damage, notify Water Department for scheduling repairs ▪ Apply a complete (N-P-K) fertilizer to all turf areas ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 5-7 day schedule. Cutting height shall be 2 to 2.5 " 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Apply approved weed and insect control products according to manufacturers' recommendations ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Overseed all irrigated athletic fields and turf areas having bare spots ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch. ▪ Fertilize new shrubs as determined by soil analysis ▪ Review shrubs on site with arborist to determine the best method of pruning flowering and non-flowering shrubs ▪ Remove dead shrubs, note their locations and schedule replacements ▪ Deadhead fading blossoms ▪ Remove spring bulbs in mid-May or after passing ▪ Add additional screened loam, lime and slow release 10-6-4 fertilizer ▪ Water daily in the morning ▪ Trash removal completed 3 times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Start scheduled tree replacements and proposed tree installations according to standard specifications and details. 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Woodlands Level I	<ul style="list-style-type: none"> ▪ Review with arborist and schedule pruning of trees infected last year by anthracnose, cankers and galls before new growth begins. ▪ Prune out dead or damaged branches of trees. ▪ Fertilize trees as determined by soil analysis. ▪ Remove stakes and guy wires installed on replacement trees planted last spring. ▪ Remove winter protection systems once weather temperature reliably rises above 45-50 degrees. ▪ Provide mulch in a two-foot diameter around the base of all new trees and trees planted the previous year. ▪ Consult with the arborist about applying dormant oil to trees with a history of aphid, scale or spider mite infestations ie. Hemlocks, beeches, honeylocust and elm. ▪ Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Apply a complete (N-P-K) fertilizer to all turf areas ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 5-7 day schedule. Cutting height shall be 3". ▪ Apply approved weed and insect control products according to manufacturers' recommendations ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Overseed all irrigated athletic fields and turf areas having bare spots ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Fertilizer if necessary ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 7-12 day schedule. Cutting height shall be 4". ▪ Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable. ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Review all athletic field surface conditions for winter damage, hazardous or unsafe conditions ▪ Weather permitting, fields can be lined for spring sports ▪ Inspect fencing for winter damage ▪ Review irrigation systems for winter damage, notify Water Department for scheduling repairs 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Apply a complete (N-P-K) fertilizer to all turf areas ▪ Based on soil tests apply lime to turf areas at the recommended amounts ▪ Mow on a 5-7 day schedule. Cutting height shall be 2 to 2.5 " ▪ Apply approved weed and insect control products according to manufacturers' recommendations ▪ Water newly seeded areas daily to maintain even surface moisture ▪ Core aerate and mat drag scheduled turf areas ▪ Overseed all irrigated athletic fields and turf areas having bare spots ▪ Dethatch turf areas ▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch. ▪ Fertilize new shrubs as determined by soil analysis ▪ Review shrubs on site with arborist to determine the best method of pruning flowering and non-flowering shrubs ▪ Remove dead shrubs, note their locations and schedule replacements ▪ Deadhead fading blossoms ▪ Remove spring bulbs in mid-May or after passing ▪ Add additional screened loam, lime and slow release 10-6-4 fertilizer 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Water daily in the morning ▪ Trash removal completed 3 times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Woodlands Level I	▪ Plant storm related replacement trees	
		▪ Maintain mulch 2-foot diameter mulch beds around new and existing trees	
		▪ Fertilize trees as determined by soil analysis	
		▪ Pick up litter and trash weekly	
	Turf Level I	▪ Apply a complete (N-P-K) fertilizer to all turf areas	
		▪ Based on soil tests apply lime to turf areas at the recommended amounts	
		▪ Mow on a 5-7 day schedule. Cutting height shall be 3".	
		▪ Apply approved weed and insect control products according to manufacturers' recommendations	
		▪ Water newly seeded areas daily to maintain even surface moisture	
		▪ Core aerate and mat drag scheduled turf areas	
		▪ Overseed all irrigated athletic fields and turf areas having bare spots	
		▪ Dethatch turf areas	
		▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary	
	Turf Level II	▪ Fertilizer if necessary	
		▪ Based on soil tests apply lime to turf areas at the recommended amounts	
		▪ Mow on a 7-12 day schedule. Cutting height shall be 4".	
		▪ Apply approved weed and insect control products according to manufacturers' recommendations. Some weeds and bare spots acceptable.	
		▪ Water newly seeded areas daily to maintain even surface moisture	
		▪ Core aerate and mat drag scheduled turf areas	
		▪ Dethatch turf areas	
		▪ Inspect mower blades each day, sharpen a minimum of once a week or as necessary	
	Planting Areas Level I	▪ Apply three inches of mulch to new plant beds, avoid placing mulch against the bark of trees and shrubs. Turn over last year's mulch layer in existing beds and top dress with new mulch.	
		▪ Fertilize new shrubs as determined by soil analysis	
		▪ Review shrubs on site with arborist to determine the best method of pruning flowering and non-flowering shrubs	
		▪ Remove dead shrubs, note their locations and schedule replacements	
		▪ Deadhead fading blossoms	
		▪ Remove spring bulbs in mid-May or after passing	
		▪ Add additional screened loam, lime and slow release 10-6-4 fertilizer	

Maintenance Calendar and Monitoring Checklist

May - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Planting Areas Level I	<ul style="list-style-type: none"> Water daily in the morning Trash removal completed 3 times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule.	
		▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.	
		▪ Mow lawns when turf is dry to minimize the chance of spreading disease.	
		▪ Water newly seeded areas daily to maintain surface moisture for successful germination.	
		▪ When approved apply a pre-emergent weed control where needed.	
		▪ When approved apply a broadleaf weed control where needed.	
		▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.	
		▪ Core aerate followed by mat dragging.	
		▪ Overseed turf areas having adequate irrigation.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule.	
		▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.	
		▪ Mow lawns when turf is dry to minimize the chance of spreading disease.	
		▪ Water newly seeded areas daily to maintain surface moisture for successful germination.	
		▪ When approved apply a pre-emergent weed control where needed.	
▪ When approved apply a broadleaf weed control where needed.			

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Turf Level I	<ul style="list-style-type: none"> Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Turf Level II	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 4" . Mow on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Turf Level III	<ul style="list-style-type: none"> Mow on a 14-18 day schedule. Cutting height shall be 4.5 ". 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials. Remove trash daily from playground area Paved surfaces are swept daily. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

JUNE - GENERAL TASKS

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none">▪ Keep all roads and paths clear of debris▪ Remove fallen trees immediately	
	Turf Level I	<ul style="list-style-type: none">▪ Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule.▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.▪ Mow lawns when turf is dry to minimize the chance of spreading disease.▪ Water newly seeded areas daily to maintain surface moisture for successful germination.▪ When approved apply a pre-emergent weed control where needed.▪ When approved apply a broadleaf weed control where needed.▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.▪ Core aerate followed by mat dragging.▪ Overseed turf areas having adequate irrigation.	
	Turf Level II	<ul style="list-style-type: none">▪ Continue scheduled mowing; cutting height shall be 4" . Mow on a 7-12 day schedule.▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.▪ Mow lawns when turf is dry to minimize the chance of spreading disease.▪ Water newly seeded areas daily to maintain surface moisture for successful germination.▪ When approved apply a pre-emergent weed control where needed.▪ When approved apply a broadleaf weed control where needed.▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.▪ Core aerate followed by mat dragging.▪ Overseed turf areas having adequate irrigation.	
	Athletic Fields Level I	<ul style="list-style-type: none">▪ Continue scheduled mowing; cutting height shall be 2.5 to 3 " . Mow on a 5-7 day schedule.▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.▪ Mow lawns when turf is dry to minimize the chance of spreading disease.▪ Water newly seeded areas daily to maintain surface moisture for successful germination.▪ When approved apply a pre-emergent weed control where needed.▪ When approved apply a broadleaf weed control where needed.▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Athletic Fields Level I	<ul style="list-style-type: none"> Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. Line and maintain athletic fields for summer sports and recreation activities. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Deadhead fading blossoms. Inspect for and remove weeds. Provide soaker hoses in shrub beds if not irrigated. Apply mulch over hoses. Water daily in the morning Maintain mulch beds. Inspect and maintain bed edging. Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Deadhead fading blossoms. Inspect for and remove weeds. Provide soaker hoses in shrub beds if not irrigated. Apply mulch over hoses. Water daily in the morning Maintain mulch beds. Inspect and maintain bed edging. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. 	

JUNE - GENERAL TASKS

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Turf Level I	<ul style="list-style-type: none">▪ Water newly seeded areas daily to maintain surface moisture for successful germination.▪ When approved apply a pre-emergent weed control where needed.▪ When approved apply a broadleaf weed control where needed.▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.▪ Core aerate followed by mat dragging.▪ Overseed turf areas having adequate irrigation.	
	Embankment Plantings Level I	<ul style="list-style-type: none">▪ Invasive removal completed by trained personnel on a monthly basis▪ Replacement plantings as necessary	
	Watercourse Level I	<ul style="list-style-type: none">▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.▪ Invasive removal completed by trained personnel on a monthly basis	
Trash Removal Level I	<ul style="list-style-type: none">▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	<ul style="list-style-type: none">▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	<ul style="list-style-type: none">▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	<ul style="list-style-type: none">▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Riverway	Circulation	<ul style="list-style-type: none">▪ Keep all roads and paths clear of debris▪ Remove fallen trees immediately	
	Woodlands Level I	<ul style="list-style-type: none">▪ Inspect trees for insects and diseases, note and report all trees and their locations to the arborist.▪ Take preventative actions, by providing mulch around trees, to protect the base of trees from string trimmer and mower damage.▪ Pick up litter and trash weekly	
	Turf Level I	<ul style="list-style-type: none">▪ Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule.▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing.▪ Mow lawns when turf is dry to minimize the chance of spreading disease.▪ Water newly seeded areas daily to maintain surface moisture for successful germination.▪ When approved apply a pre-emergent weed control where needed.▪ When approved apply a broadleaf weed control where needed.▪ Inspect turf areas for lawn insects. Apply approved insect control materials where needed.▪ Core aerate followed by mat dragging.▪ Overseed turf areas having adequate irrigation.	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level II	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 4" . Mow on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Deadhead fading blossoms. Inspect for and remove weeds. Provide soaker hoses in shrub beds if not irrigated. Apply mulch over hoses. Water daily in the morning Maintain mulch beds. Inspect and maintain bed edging. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	Inspect trees for insects and diseases, note and report all trees and their locations to the arborist.	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Woodlands Level I	<ul style="list-style-type: none"> Take preventative actions, by providing mulch around trees, to protect the base of trees from string trimmer and mower damage. Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Turf Level II	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 4" . Mow on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 2.5 to 3 ". Mow on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. 	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Athletic Fields Level I	<ul style="list-style-type: none"> Overseed turf areas having adequate irrigation. Line and maintain athletic fields for summer sports and recreation activities. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Deadhead fading blossoms. Inspect for and remove weeds. Provide soaker hoses in shrub beds if not irrigated. Apply mulch over hoses. Water daily in the morning Maintain mulch beds. Inspect and maintain bed edging. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Inspect trees for insects and diseases, note and report all trees and their locations to the arborist. Take preventative actions, by providing mulch around trees, to protect the base of trees from string trimmer and mower damage. Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 3" . Mow on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. 	

Maintenance Calendar and Monitoring Checklist

JUNE - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Turf Level I	<ul style="list-style-type: none"> When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Turf Level II	<ul style="list-style-type: none"> Continue scheduled mowing; cutting height shall be 4" . Mow on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing. Mow lawns when turf is dry to minimize the chance of spreading disease. Water newly seeded areas daily to maintain surface moisture for successful germination. When approved apply a pre-emergent weed control where needed. When approved apply a broadleaf weed control where needed. Inspect turf areas for lawn insects. Apply approved insect control materials where needed. Core aerate followed by mat dragging. Overseed turf areas having adequate irrigation. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Deadhead fading blossoms. Inspect for and remove weeds. Provide soaker hoses in shrub beds if not irrigated. Apply mulch over hoses. Water daily in the morning Maintain mulch beds. Inspect and maintain bed edging. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Water lawns as needed, providing a minimum of 2" of water/week	
		▪ Inspect irrigation systems with water department.	
		▪ Provide water cannon system for large fields and open spaces	
		▪ Inspect for lawn insects	
		▪ Core aerate compacted fields followed by mat dragging	
		▪ Where adequate irrigation and water cannon usage is available, overseed	
		▪ Mow at a height of 3" on a 5 -7 day mowing schedule	
		▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing	
		▪ Mow lawns when turf is dry to minimize the chance of spreading disease	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Water lawns as needed, providing a minimum of 2" of water/week	
		▪ Inspect irrigation systems with water department.	
		▪ Provide water cannon system for large fields and open spaces	
		▪ Inspect for lawn insects	
		▪ Core aerate compacted fields followed by mat dragging	
		▪ Where adequate irrigation and water cannon usage is available, overseed	
		▪ Mow at a height of 3" on a 5 -7 day mowing schedule	
		▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest		<ul style="list-style-type: none"> Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level II	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 4" on a 7-12 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level III	<ul style="list-style-type: none"> Mow on a 14-18 day schedule. Cutting height shall be 4". 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials. Remove trash daily from playground area Paved surfaces are swept daily. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level I	<ul style="list-style-type: none"> ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging ▪ Where adequate irrigation and water cannon usage is available, overseed ▪ Mow at a height of 3" on a 5 -7 day mowing schedule ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Water lawns as needed, providing a minimum of 2" of water/week ▪ Inspect irrigation systems with water department. ▪ Provide water cannon system for large fields and open spaces ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging ▪ Where adequate irrigation and water cannon usage is available, overseed ▪ Mow at a height of 4" on a 7-12 day mowing schedule ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Water lawns as needed, providing a minimum of 2" of water/week ▪ Inspect irrigation systems with water department. ▪ Provide water cannon system for large fields and open spaces ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging ▪ Where adequate irrigation and water cannon usage is available, overseed ▪ Mow at a height of 3" on a 5 -7 day mowing schedule ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Continue to line and maintain ball fields for summer leagues. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Maintain daily and nighttime watering schedule ▪ Weed beds and deadhead fading blossoms. ▪ Prune deadwood from plants as needed. ▪ Train vines and roses ▪ Remove dead plants noting locations. Create replacement schedule ▪ Maintain plant bed edging and mulch. 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Gardens Level I	<ul style="list-style-type: none"> ▪ Trash removal completed three times per week ▪ Maintain daily and nighttime watering schedule ▪ Weed beds and deadhead fading blossoms. ▪ Prune deadwood from plants as needed. ▪ Train vines and roses 	
	Gardens Level I	<ul style="list-style-type: none"> ▪ Remove dead plants noting locations. Create replacement schedule ▪ Maintain plant bed edging and mulch. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Water lawns as needed, providing a minimum of 2" of water/week ▪ Inspect irrigation systems with water department. ▪ Provide water cannon system for large fields and open spaces ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging ▪ Where adequate irrigation and water cannon usage is available, overseed ▪ Mow at a height of 3" on a 5 -7 day mowing schedule ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Watercourse Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Riverway	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Water newly planted trees, avoid wetting trunks and foliage. Prune and remove suckers from cherry, crab and other ornamental trees as directed by arborist. Inspect and maintain mulch beds at the base of trees Inspect for insects like the tent caterpillar, remove infected branches by pruning. Inspect for other pest problems, note problem areas and notify the arborist Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 3" on a 5 -7 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level II	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 4" on a 7-12 day mowing schedule 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level II	<ul style="list-style-type: none"> Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Planting Areas Level I	<ul style="list-style-type: none"> Maintain daily and nighttime watering schedule Weed beds and deadhead fading blossoms. Prune deadwood from plants as needed. Train vines and roses Remove dead plants noting locations. Create replacement schedule 	
	Planting Areas Level I	<ul style="list-style-type: none"> Maintain plant bed edging and mulch. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticeable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Water newly planted trees, avoid wetting trunks and foliage. Prune and remove suckers from cherry, crab and other ornamental trees as directed by arborist. Inspect and maintain mulch beds at the base of trees Inspect for insects like the tent caterpillar, remove infected branches by pruning. Inspect for other pest problems, note problem areas and notify the arborist Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Turf Level I	<ul style="list-style-type: none"> Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 3" on a 5 -7 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level II	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 4" on a 7-12 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Water lawns as needed, providing a minimum of 2" of water/week Inspect irrigation systems with water department. Provide water cannon system for large fields and open spaces Inspect for lawn insects Core aerate compacted fields followed by mat dragging Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 3" on a 5 -7 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease Continue to line and maintain ball fields for summer leagues. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Maintain daily and nighttime watering schedule Weed beds and deadhead fading blossoms. Prune deadwood from plants as needed. Train vines and roses Remove dead plants noting locations. Create replacement schedule Maintain plant bed edging and mulch. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis 	

▪ Replacement plantings as necessary

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Water newly planted trees, avoid wetting trunks and foliage. ▪ Prune and remove suckers from cherry, crab and other ornamental trees as directed by arborist. ▪ Inspect and maintain mulch beds at the base of trees ▪ Inspect for insects like the tent caterpillar, remove infected branches by pruning. ▪ Inspect for other pest problems, note problem areas and notify the arborist ▪ Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Water lawns as needed, providing a minimum of 2" of water/week ▪ Inspect irrigation systems with water department. ▪ Provide water cannon system for large fields and open spaces ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging ▪ Where adequate irrigation and water cannon usage is available, overseed ▪ Mow at a height of 3" on a 5 -7 day mowing schedule ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Water lawns as needed, providing a minimum of 2" of water/week ▪ Inspect irrigation systems with water department. ▪ Provide water cannon system for large fields and open spaces ▪ Inspect for lawn insects ▪ Core aerate compacted fields followed by mat dragging 	

Maintenance Calendar and Monitoring Checklist

JULY - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Turf Level II	<ul style="list-style-type: none"> Where adequate irrigation and water cannon usage is available, overseed Mow at a height of 4" on a 7-12 day mowing schedule Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease 	
	Planting Areas Level I	<ul style="list-style-type: none"> Maintain daily and nighttime watering schedule Weed beds and deadhead fading blossoms. Prune deadwood from plants as needed. Train vines and roses Remove dead plants noting locations. Create replacement schedule Maintain plant bed edging and mulch. Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

AUGUST - GENERAL TASKS

AUGUST - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule.	
		▪ Inspect lawn mower blades, keep blades sharp, replace if necessary	
		▪ Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease	
		▪ Water daily using irrigation systems, water truck or water cannon	
		▪ Aerate and overseed compacted turf areas	
		▪ Inspect for and reseed bare areas as needed.	
		▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application.	
		▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.		
	▪ Invasive removal completed by trained personnel on a monthly basis		
Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule.	
		▪ Inspect lawn mower blades, keep blades sharp, replace if necessary	
		▪ Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease	
		▪ Water daily using irrigation systems, water truck or water cannon	
		▪ Aerate and overseed compacted turf areas	
		▪ Inspect for and reseed bare areas as needed.	
		▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application.	
		▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application.	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Turf Level II	<ul style="list-style-type: none"> Continue to mow open fields at a height of 4", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 7-12 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Turf Level III	<ul style="list-style-type: none"> Continue to mow open fields at a height of 4.5", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 14-18 day schedule. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials. Remove trash daily from playground area Paved surfaces are swept daily. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease 	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level I	<ul style="list-style-type: none"> Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Turf Level II	<ul style="list-style-type: none"> Continue to mow open fields at a height of 4", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 7-12 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Shrubs and flower beds need to be watered deeply during the hot and dry period of the summer. Supply water by irrigation system, water cannon or hand held hose from water truck. Weed beds and deadhead fading blossoms Maintain plant bed edging and mulch Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Shrubs and flower beds need to be watered deeply during the hot and dry period of the summer. Supply water by irrigation system, water cannon or hand held hose from water truck. Weed beds and deadhead fading blossoms Maintain plant bed edging and mulch 	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Water trees, avoiding wetting trunks and foliage ▪ Maintain mulch around trees to prevent damage by lawn mowing and weed trimming operations ▪ Prune and remove suckers from the base of trees as they appear ▪ Rake and remove fallen leaves and fruit to prevent any insect and disease cycles from continuing ▪ Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. ▪ Inspect lawn mower blades, keep blades sharp, replace if necessary ▪ Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease ▪ Water daily using irrigation systems, water truck or water cannon ▪ Aerate and overseed compacted turf areas ▪ Inspect for and reseed bare areas as needed. ▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Continue to mow open fields at a height of 4", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 7-12 day schedule. ▪ Inspect lawn mower blades, keep blades sharp, replace if necessary ▪ Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease ▪ Water daily using irrigation systems, water truck or water cannon ▪ Aerate and overseed compacted turf areas ▪ Inspect for and reseed bare areas as needed. ▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Shrubs and flower beds need to be watered deeply during the hot and dry period of the summer. Supply water by irrigation system, water cannon or hand held hose from water truck. ▪ Weed beds and deadhead fading blossoms ▪ Maintain plant bed edging and mulch ▪ Trash removal completed three times per week 	

AUGUST - GENERAL TASKS

AUGUST - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Embankment Plantings Level I	<ul style="list-style-type: none">Invasive removal completed by trained personnel on a monthly basisReplacement plantings as necessary	
	Watercourse Level I	<ul style="list-style-type: none">Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	<ul style="list-style-type: none">Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	<ul style="list-style-type: none">Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	<ul style="list-style-type: none">Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	<ul style="list-style-type: none">Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none">Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none">Keep all roads and paths clear of debrisRemove fallen trees immediately	
	Woodlands Level I	<ul style="list-style-type: none">Water trees, avoiding wetting trunks and foliageMaintain mulch around trees to prevent damage by lawn mowing and weed trimming operationsPrune and remove suckers from the base of trees as they appearRake and remove fallen leaves and fruit to prevent any insect and disease cycles from continuingPick up litter and trash weekly	
	Turf Level I	<ul style="list-style-type: none">Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule.Inspect lawn mower blades, keep blades sharp, replace if necessaryMow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading diseaseWater daily using irrigation systems, water truck or water cannonAerate and overseed compacted turf areasInspect for and reseed bare areas as needed.Inspect turf for ground insects and apply approved materials. Water well into ground after application.	
	Turf Level II	<ul style="list-style-type: none">Continue to mow open fields at a height of 4", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 7-12 day schedule.Inspect lawn mower blades, keep blades sharp, replace if necessaryMow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Turf Level II	<ul style="list-style-type: none"> ▪ Water daily using irrigation systems, water truck or water cannon ▪ Aerate and overseed compacted turf areas ▪ Inspect for and reseed bare areas as needed. ▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. ▪ Inspect lawn mower blades, keep blades sharp, replace if necessary ▪ Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease ▪ Water daily using irrigation systems, water truck or water cannon ▪ Aerate and overseed compacted turf areas ▪ Inspect for and reseed bare areas as needed. ▪ Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Shrubs and flower beds need to be watered deeply during the hot and dry period of the summer. Supply water by irrigation system, water cannon or hand held hose from water truck. ▪ Weed beds and deadhead fading blossoms ▪ Maintain plant bed edging and mulch ▪ Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Water trees, avoiding wetting trunks and foliage Maintain mulch around trees to prevent damage by lawn mowing and weed trimming operations Prune and remove suckers from the base of trees as they appear Rake and remove fallen leaves and fruit to prevent any insect and disease cycles from continuing Pick up litter and trash weekly 	
	Turf Level I	<ul style="list-style-type: none"> Continue to mow open fields at a height of 3", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 5-7 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Turf Level II	<ul style="list-style-type: none"> Continue to mow open fields at a height of 4", do not remove more than 1/3 of the leaf blades at a mowing. Mow on a 7-12 day schedule. Inspect lawn mower blades, keep blades sharp, replace if necessary Mow when turf is dry to minimize grass clumping, thatch build up and the chance of spreading disease Water daily using irrigation systems, water truck or water cannon Aerate and overseed compacted turf areas Inspect for and reseed bare areas as needed. Inspect turf for ground insects and apply approved materials. Water well into ground after application. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Shrubs and flower beds need to be watered deeply during the hot and dry period of the summer. Supply water by irrigation system, water cannon or hand held hose from water truck. Weed beds and deadhead fading blossoms Maintain plant bed edging and mulch Trash removal completed three times per week 	

Maintenance Calendar and Monitoring Checklist

AUGUST - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. Core aerate drag mat and over seed all areas with compacted soils Top dress turf areas with screened loam and sand Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings Mow at a height of 3" on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing Mow lawns when turf is dry to minimize the chance of spreading disease Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels and benches and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. Core aerate drag mat and over seed all areas with compacted soils Top dress turf areas with screened loam and sand 	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Turf Level I	<ul style="list-style-type: none"> ▪ Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings ▪ Mow at a height of 3" on a 5-7 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Turf Level II	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize if necessary ▪ Mow at a height of 4" on a 7-12 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Turf Level III	▪ Reduce mowing height to 2.5-3". Mow on a 14-18 day schedule.	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Playgrounds Level I	▪ Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days.	

SEPTEMBER - GENERAL TASKS

SEPTEMBER - GENERAL TASKS				
Sector	Feature Type/Area	Maintenance Action	Task Completed	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Playgrounds Level I	▪ Inspect safety surface materials at all playgrounds. Schedule additional or replacement surface materials.		
		▪ Remove trash daily from playground area		
		▪ Paved surfaces are swept daily.		
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	▪ Keep all roads and paths clear of debris		
		▪ Remove fallen trees immediately		
	Turf Level I	▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results.		
		▪ Core aerate drag mat and over seed all areas with compacted soils		
		▪ Top dress turf areas with screened loam and sand		
		▪ Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination		
		▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings		
		▪ Mow at a height of 3" on a 5-7 day schedule.		
		▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing		
		▪ Mow lawns when turf is dry to minimize the chance of spreading disease		
		▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions		
		Turf Level II	▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results.	
			▪ Core aerate drag mat and over seed all areas with compacted soils	
			▪ Top dress turf areas with screened loam and sand	
			▪ Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination	
▪ Fertilize if necessary				
▪ Mow at a height of 4" on a 7-12 day schedule.				
▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing				

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Turf Level II	<ul style="list-style-type: none"> ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings ▪ Mow at a height of 2.5-3" ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions ▪ Continue to line and maintain ball fields for summer leagues. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Rake and remove fallen leaves, twigs, fruits and debris throughout sites ▪ Review shrub pruning schedule ▪ Install new and replacement plants as needed ▪ Water all beds on a daily basis ▪ Maintain plant bed edging and mulch surface ▪ Train and support vines and climbing roses ▪ Inspect for and remove weeds ▪ During the last week, start removing all annual flowers from beds ▪ Install fall flowers in designated beds ▪ Start to prepare designated beds for the installation of fall bulbs. Turn over existing bed materials, regrade and edge area to proposed design ▪ Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> ▪ Rake and remove fallen leaves, twigs, fruits and debris throughout sites ▪ Review shrub pruning schedule ▪ Install new and replacement plants as needed ▪ Water all beds on a daily basis 	

SEPTEMBER - GENERAL TASKS

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Gardens Level I	<ul style="list-style-type: none">▪ Maintain plant bed edging and mulch surface▪ Train and support vines and climbing roses▪ Inspect for and remove weeds▪ During the last week, start removing all annual flowers from beds▪ Install fall flowers in designated beds▪ Start to prepare designated beds for the installation of fall bulbs. Turn over existing bed materials, regrade and edge area to proposed design	
	Embankment Plantings Level I	<ul style="list-style-type: none">▪ Invasive removal completed by trained personnel on a monthly basis▪ Replacement plantings as necessary	
Watercourse Level I	<ul style="list-style-type: none">▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.▪ Invasive removal completed by trained personnel on a monthly basis		
Trash Removal Level I	<ul style="list-style-type: none">▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.		
Paved Surfaces Level II	<ul style="list-style-type: none">▪ Swept and cleaned when there is a noticable accumulation of debris.		
Park Furniture Level I	<ul style="list-style-type: none">▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.		
Structures Level I	<ul style="list-style-type: none">▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none">▪ Keep all roads and paths clear of debris▪ Remove fallen trees immediately	
	Turf Level I	<ul style="list-style-type: none">▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results.▪ Core aerate drag mat and over seed all areas with compacted soils▪ Top dress turf areas with screened loam and sand▪ Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings▪ Mow at a height of 3" on a 5-7 day schedule.▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing▪ Mow lawns when turf is dry to minimize the chance of spreading disease▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions	

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Riverway	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately
	Woodlands Level I	<ul style="list-style-type: none"> Remove dead, diseased and damaged trees, suckers and crossing branches. Prune selective trees so as to improve their form and structural stability. Inspect for insect damage and any signs of decay or disease. Notify arborist for proper treatment. Remove storm-damaged trees and stumps as necessary Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations Install new and replacement trees Inspect guying systems on trees installed during the spring. Adjust, repair or replace as necessary Consult with arborist on deep root fertilizing certain trees within the park system Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. Core aerate drag mat and over seed all areas with compacted soils Top dress turf areas with screened loam and sand Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings Mow at a height of 3" on a 5-7 day schedule. 	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level I	<ul style="list-style-type: none"> ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Turf Level II	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize if necessary ▪ Mow at a height of 4" on a 7-12 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Rake and remove fallen leaves, twigs, fruits and debris throughout sites ▪ Review shrub pruning schedule ▪ Install new and replacement plants as needed ▪ Water all beds on a daily basis ▪ Maintain plant bed edging and mulch surface ▪ Train and support vines and climbing roses ▪ Inspect for and remove weeds ▪ During the last week, start removing all annual flowers from beds ▪ Install fall flowers in designated beds ▪ Start to prepare designated beds for the installation of fall bulbs. Turn over existing bed materials, regrade and edge area to proposed design ▪ Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Remove dead, diseased and damaged trees, suckers and crossing branches. Prune selective trees so as to improve their form and structural stability. ▪ Inspect for insect damage and any signs of decay or disease. Notify arborist for proper treatment. ▪ Remove storm-damaged trees and stumps as necessary ▪ Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations ▪ Install new and replacement trees ▪ Inspect guying systems on trees installed during the spring. Adjust, repair or replace as necessary ▪ Consult with arborist on deep root fertilizing certain trees within the park system ▪ Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeding should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings ▪ Mow at a height of 3" on a 5-7 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease 	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Turf Level II	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize if necessary ▪ Mow at a height of 4" on a 7-12 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions 	
	Athletic Fields Level I	<ul style="list-style-type: none"> ▪ If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. ▪ Core aerate drag mat and over seed all areas with compacted soils ▪ Top dress turf areas with screened loam and sand ▪ Reseed bare spots and overused areas as necessary. Seeing should be completed by the end of September or by the second week of October depending on weather conditions. Water daily to keep soil surface moist during germination ▪ Fertilize all turf areas with a complete (N-P-K) fertilizer containing 50% Water Insoluble Nitrogen (WIN) at a rate of 2 lb/1000 square feet. Use fertilizer with a 3-1-2 ratio, ie. 15-5-10. Check the fertilizer bed for the recommended spreader settings ▪ Mow at a height of 2.5-3" ▪ Keep lawn mower blades sharp and do not remove more than 1/3 of the leaf blades at a mowing ▪ Mow lawns when turf is dry to minimize the chance of spreading disease ▪ Review and identify weeds in turf areas. Apply the recommended and approved weed controls according to manufacturers directions ▪ Continue to line and maintain ball fields for summer leagues. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Rake and remove fallen leaves, twigs, fruits and debris throughout sites ▪ Review shrub pruning schedule ▪ Install new and replacement plants as needed ▪ Water all beds on a daily basis ▪ Maintain plant bed edging and mulch surface ▪ Train and support vines and climbing roses 	

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Planting Areas Level I	<ul style="list-style-type: none"> Inspect for and remove weeds During the last week, start removing all annual flowers from beds Install fall flowers in designated beds Start to prepare designated beds for the installation of fall bulbs. Turn over existing bed materials, regrade and edge area to proposed design Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Remove dead, diseased and damaged trees, suckers and crossing branches. Prune selective trees so as to improve their form and structural stability. Inspect for insect damage and any signs of decay or disease. Notify arborist for proper treatment. Remove storm-damaged trees and stumps as necessary Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations Install new and replacement trees Inspect guying systems on trees installed during the spring. Adjust, repair or replace as necessary Consult with arborist on deep root fertilizing certain trees within the park system Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> If not done in the spring, take new samples for testing. Apply soil amendments and fertilizer as recommended by soil test results. Core aerate drag mat and over seed all areas with compacted soils Top dress turf areas with screened loam and sand 	

[illegible]

Maintenance Calendar and Monitoring Checklist

SEPTEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 7 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Mow at a height of 3" on a 5-7 day schedule.	
		▪ Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing.	
		▪ Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates.	
		▪ Schedule core aeration, mat dragging	
		▪ Top dress damaged turf areas with loam/sand	
		▪ Over seed all damaged and heavily used turf areas until mid October or as weather permits	
		▪ Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
	Turf Level I	▪ Mow at a height of 3" on a 5-7 day schedule.	
		▪ Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing.	
		▪ Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates.	
		▪ Schedule core aeration, mat dragging	
		▪ Top dress damaged turf areas with loam/sand	
		▪ Over seed all damaged and heavily used turf areas until mid October or as weather permits	
		▪ Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November.	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Turf Level II	<ul style="list-style-type: none"> Mow at a height of 4" on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Turf Level III	<ul style="list-style-type: none"> Mow at a height of 4" on a 14-18 day schedule. 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect for damaged equipment and hazardous conditions. Inspect for loose safety base materials around play structures, add and regrade material where necessary Inspect safety tiles and poured in place materials. Remove, replace or repair as necessary. Remove or repair damaged equipment 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Mow at a height of 3" on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. 	

OCTOBER - GENERAL TASKS

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Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Planting Areas Level I	<ul style="list-style-type: none"> Start installing bulbs during the last week of the month as specified and according to design All bulb beds are to be edged and covered with two to three inches of mulch Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Rake and remove leaves, fruit and debris from grounds Install new or replacement deciduous or evergreen shrubs Weed, edge and mulch beds Continue to install fall flowers in designated beds Continue to remove all annuals from flowerbeds as scheduled Remove fall flowers after first frost Continue to prepare designated beds for bulb installations Prepare beds and containers by adding soil amenities as necessary (peat moss, compost and bone meal) Start installing bulbs during the last week of the month as specified and according to design All bulb beds are to be edged and covered with two to three inches of mulch Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. 	
	Park Furniture Level I	<ul style="list-style-type: none"> Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Turf Level I	<ul style="list-style-type: none"> Mow at a height of 3" on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging 	

OCTOBER - GENERAL TASKS

OCTOBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Turf Level I	<ul style="list-style-type: none">▪ Top dress damaged turf areas with loam/sand▪ Over seed all damaged and heavily used turf areas until mid October or as weather permits▪ Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November.	
	Embankment Plantings Level I	<ul style="list-style-type: none">▪ Invasive removal completed by trained personnel on a monthly basis▪ Replacement plantings as necessary	
	Watercourse Level I	<ul style="list-style-type: none">▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	<ul style="list-style-type: none">▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	<ul style="list-style-type: none">▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Park Furniture Level I	<ul style="list-style-type: none">▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
Structures Level I	<ul style="list-style-type: none">▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.		
Riverway	Circulation	<ul style="list-style-type: none">▪ Keep all roads and paths clear of debris▪ Remove fallen trees immediately	
	Woodlands Level I	<ul style="list-style-type: none">▪ Install new or replacement deciduous or evergreen trees▪ Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations▪ Inspect for diseased and unhealthy trees. Consult with arborist for scheduling pruning or removal▪ Consult with arborist and schedule trees that need deep root feeding▪ Pick up litter and trash regularly	
	Turf Level I	<ul style="list-style-type: none">▪ Mow at a height of 3" on a 5-7 day schedule.▪ Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing.▪ Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates.▪ Schedule core aeration, mat dragging▪ Top dress damaged turf areas with loam/sand▪ Over seed all damaged and heavily used turf areas until mid October or as weather permits▪ Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November.	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Turf Level II	<ul style="list-style-type: none"> ▪ Mow at a height of 4" on a 7-12 day schedule. ▪ Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. ▪ Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. ▪ Schedule core aeration, mat dragging ▪ Top dress damaged turf areas with loam/sand ▪ Over seed all damaged and heavily used turf areas until mid October or as weather permits ▪ Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Planting Areas Level I	<ul style="list-style-type: none"> ▪ Rake and remove leaves, fruit and debris from grounds ▪ Install new or replacement deciduous or evergreen shrubs ▪ Weed, edge and mulch beds ▪ Continue to install fall flowers in designated beds ▪ Continue to remove all annuals from flowerbeds as scheduled ▪ Remove fall flowers after first frost ▪ Continue to prepare designated beds for bulb installations ▪ Prepare beds and containers by adding soil amenities as necessary (peat moss, compost and bone meal) ▪ Start installing bulbs during the last week of the month as specified and according to design ▪ All bulb beds are to be edged and covered with two to three inches of mulch ▪ Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. 	
	Soft Surface Level I	<ul style="list-style-type: none"> ▪ Patch, refill and roll stonedust pathways as necessary 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Install new or replacement deciduous or evergreen trees Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations Inspect for diseased and unhealthy trees. Consult with arborist for scheduling pruning or removal Consult with arborist and schedule trees that need deep root feeding Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> Mow at a height of 3" on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Turf Level II	<ul style="list-style-type: none"> Mow at a height of 4" on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Athletic Fields Level I	<ul style="list-style-type: none"> Reduce mowing height to 2.5 " Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand 	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Athletic Fields Level I	<ul style="list-style-type: none"> Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Rake and remove leaves, fruit and debris from grounds Install new or replacement deciduous or evergreen shrubs Weed, edge and mulch beds Continue to install fall flowers in designated beds Continue to remove all annuals from flowerbeds as scheduled Remove fall flowers after first frost Continue to prepare designated beds for bulb installations Prepare beds and containers by adding soil amenities as necessary (peat moss, compost and bone meal) Start installing bulbs during the last week of the month as specified and according to design All bulb beds are to be edged and covered with two to three inches of mulch Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately 	
	Woodlands Level I	<ul style="list-style-type: none"> Install new or replacement deciduous or evergreen trees Maintain mulch rings around tree trunks to prevent any damage during lawn cutting operations Inspect for diseased and unhealthy trees. Consult with arborist for scheduling pruning or removal Consult with arborist and schedule trees that need deep root feeding 	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Woodlands Level I	<ul style="list-style-type: none"> Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> Mow at a height of 3" on a 5-7 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Turf Level II	<ul style="list-style-type: none"> Mow at a height of 4" on a 7-12 day schedule. Keep lawn mower blades sharp and do not remove more than one third of the leaf blades at a mowing. Review latest soil reports and apply recommended amounts of fall fertilizer at the appropriate rates. Schedule core aeration, mat dragging Top dress damaged turf areas with loam/sand Over seed all damaged and heavily used turf areas until mid October or as weather permits Review latest soil tests for lime requirements. Set schedule to start liming by mid October or by early November. 	
	Planting Areas Level I	<ul style="list-style-type: none"> Rake and remove leaves, fruit and debris from grounds Install new or replacement deciduous or evergreen shrubs Weed, edge and mulch beds Continue to install fall flowers in designated beds Continue to remove all annuals from flowerbeds as scheduled Remove fall flowers after first frost Continue to prepare designated beds for bulb installations Prepare beds and containers by adding soil amenities as necessary (peat moss, compost and bone meal) Start installing bulbs during the last week of the month as specified and according to design All bulb beds are to be edged and covered with two to three inches of mulch Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	

Maintenance Calendar and Monitoring Checklist

OCTOBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Apply fall applications of lime and fertilizer	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	▪ Apply fall applications of lime and fertilizer	
	Turf Level II	▪ Apply fall applications of lime and fertilizer	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. ▪ Shovel and remove snow as needed 	
	Playgrounds Level I	<ul style="list-style-type: none"> ▪ Inspect for damaged equipment and hazardous conditions. ▪ Inspect for loose safety base materials around play structures, add and regrade material where necessary 	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Playgrounds Level I	<ul style="list-style-type: none"> Inspect safety tiles and poured in place materials. Remove, replace or repair as necessary. Remove or repair damaged equipment Shovel and remove snow as needed 	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	Apply fall applications of lime and fertilizer	
	Turf Level II	Apply fall applications of lime and fertilizer	
	Athletic Fields Level I	Apply fall applications of lime and fertilizer	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove fall leaves, dead branches and debris from all surfaces. Review those plants which require winter protection Inspect shrubs and prune any diseased or damaged wood Remove one third of the oldest wood on non-flowering shrubs to improve growth Inspect shrubs for insects, consult with arborist and schedule appropriate controls Trash removal completed three times per week 	
	Gardens Level I	<ul style="list-style-type: none"> Remove fall leaves, dead branches and debris from all surfaces. Review those plants which require winter protection Inspect shrubs and prune any diseased or damaged wood Remove one third of the oldest wood on non-flowering shrubs to improve growth Inspect shrubs for insects, consult with arborist and schedule appropriate controls Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. Shovel and remove snow as needed 	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens Central: Rose Garden/ Clemente Field	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Back Bay Fens South and Sears Parking Lot	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Reduce mowing height to 2.5 " Mow on a 5-7 day schedule. ▪ Apply fall applications of lime and fertilizer 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	<ul style="list-style-type: none"> ▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day. 	
Riverway	Paved Surfaces Level II	<ul style="list-style-type: none"> ▪ Swept and cleaned when there is a noticable accumulation of debris. ▪ Shovel and remove snow as needed 	
	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels and benches and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> ▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> ▪ Prune and remove storm related trees ▪ All newly planted trees should be wrapped with a commercial tree wrap to protect them from sunscald and frost crackling ▪ Inspect tree stakes and guy wires and adjust where necessary ▪ Inspect trees for insects and schedule the appropriate controls ▪ Pick up litter and trash regularly 	
	Turf Level I	<ul style="list-style-type: none"> ▪ Apply fall applications of lime and fertilizer 	
	Turf Level II	<ul style="list-style-type: none"> ▪ Apply fall applications of lime and fertilizer 	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Riverway	Planting Areas Level I	<ul style="list-style-type: none"> Remove fall leaves, dead branches and debris from all surfaces. Review those plants which require winter protection Inspect shrubs and prune any diseased or damaged wood Remove one third of the oldest wood on non-flowering shrubs to improve growth Inspect shrubs for insects, consult with arborist and schedule appropriate controls Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	<ul style="list-style-type: none"> Swept and cleaned when there is a noticable accumulation of debris. Shovel and remove snow as needed 	
	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> Prune and remove storm related trees All newly planted trees should be wrapped with a commercial tree wrap to protect them from sunscald and frost crackling Inspect tree stakes and guy wires and adjust where necessary Inspect trees for insects and schedule the appropriate controls Pick up litter and trash regularly 	
	Turf Level I	Apply fall applications of lime and fertilizer	
	Turf Level II	Apply fall applications of lime and fertilizer	
	Athletic Fields Level I	Apply fall applications of lime and fertilizer	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove fall leaves, dead branches and debris from all surfaces. Review those plants which require winter protection 	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park North: Leverett Pond/Daisy Pond	Planting Areas Level I	<ul style="list-style-type: none"> Inspect shrubs and prune any diseased or damaged wood Remove one third of the oldest wood on non-flowering shrubs to improve growth Inspect shrubs for insects, consult with arborist and schedule appropriate controls Trash removal completed three times per week 	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Swept and cleaned when there is a noticable accumulation of debris.	
		Shovel and remove snow as needed	
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Soft Surface Level I	Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Woodlands Level I	<ul style="list-style-type: none"> Prune and remove storm related trees All newly planted trees should be wrapped with a commercial tree wrap to protect them from sunscald and frost crackling Inspect tree stakes and guy wires and adjust where necessary Inspect trees for insects and schedule the appropriate controls Pick up litter and trash regularly 	
	Turf Level I	Apply fall applications of lime and fertilizer	
	Turf Level II	Apply fall applications of lime and fertilizer	
	Planting Areas Level I	<ul style="list-style-type: none"> Remove fall leaves, dead branches and debris from all surfaces. Review those plants which require winter protection Inspect shrubs and prune any diseased or damaged wood Remove one third of the oldest wood on non-flowering shrubs to improve growth Inspect shrubs for insects, consult with arborist and schedule appropriate controls Trash removal completed three times per week 	

Maintenance Calendar and Monitoring Checklist

NOVEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted Park South: Wards Pond/ Willow Pond/ Nickerson Hill	Embankment Plantings Level I	<ul style="list-style-type: none"> ▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> ▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Swept and cleaned when there is a noticable accumulation of debris.	
		▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Patch, refill and roll stonedust pathways as necessary	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	

Maintenance Calendar and Monitoring Checklist

DECEMBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Charlesgate	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
Back Bay Fens North: Victory Gardens/ Mother's Rest	Paved Surfaces Level II	Shovel and remove snow as needed	
	Park Furniture Level I	Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	<ul style="list-style-type: none"> Monitor structures for storm damage Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	
	Circulation	<ul style="list-style-type: none"> Keep all roads and paths clear of debris Remove fallen trees immediately Shovel and remove snow as needed 	
	Turf Level I	Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	<ul style="list-style-type: none"> Invasive removal completed by trained personnel on a monthly basis Replacement plantings as necessary 	
	Watercourse Level I	<ul style="list-style-type: none"> Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. Invasive removal completed by trained personnel on a monthly basis 	
	Trash Removal Level I	Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	Shovel and remove snow as needed	
	Playgrounds Level I	<ul style="list-style-type: none"> Inspect all playground and park equipment for damage and hazardous conditions. Note all areas for repair or replacement. Repairs are done within 3-5 working days. Remove trash daily from playground area Snow removal as necessary 	

Maintenance Calendar and Monitoring Checklist

DECEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens North: Victory Gardens/ Mother's Rest	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Back Bay Fens Central: Rose Garden/ Clemente Field	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Athletic Fields Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact. ▪ Maintain signs indicating that playing fields are closed for the season.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
Back Bay Fens South and Sears Parking Lot	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Circulation	▪ Keep all roads and paths clear of debris ▪ Remove fallen trees immediately ▪ Shovel and remove snow as needed	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis ▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris. ▪ Invasive removal completed by trained personnel on a monthly basis	

Maintenance Calendar and Monitoring Checklist

DECEMBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Back Bay Fens South and Sears Parking Lot	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Riverway	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
		▪ Shovel and remove snow as needed	
	Woodlands Level I	▪ Pick up litter and trash regularly	
		▪ Remove storm related tree damage and pruning of trees along the tree lawns that present a public safety hazard	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
		▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
Olmsted Park North: Leverett Pond/Daisy Pond	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
		▪ Shovel and remove snow as needed	
	Woodlands Level I	▪ Pick up litter and trash regularly	
		▪ Remove storm related tree damage and pruning of trees along the tree lawns that present a public safety hazard	

Maintenance Calendar and Monitoring Checklist

DECEMBER - GENERAL TASKS

Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted park north: Leverett Pond/Daisy Pond	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Athletic Fields Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
		▪ Maintain signs indicating that playing fields are closed for the season.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	
	Park Furniture Level I	▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements.	
	Structures Level I	▪ Monitor structures for storm damage	
		▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days.	
	Circulation	▪ Keep all roads and paths clear of debris	
		▪ Remove fallen trees immediately	
		▪ Shovel and remove snow as needed	
	Woodlands Level I	▪ Pick up litter and trash regularly	
		▪ Remove storm related tree damage and pruning of trees along the tree lawns that present a public safety hazard	
	Turf Level I	▪ Snow fence that was erected to protect seeded areas is inspected weekly to ensure that it is intact.	
	Embankment Plantings Level I	▪ Invasive removal completed by trained personnel on a monthly basis	
		▪ Replacement plantings as necessary	
	Watercourse Level I	▪ Trash removed from watercourse weekly. A small boat is used monthly to access the watercourse and remove debris.	
		▪ Invasive removal completed by trained personnel on a monthly basis	
	Trash Removal Level I	▪ Trash is removed minimum of once a day 5 days/week. No overflowing cans. May require more than one servicing per day.	
	Paved Surfaces Level II	▪ Shovel and remove snow as needed	
	Soft Surface Level I	▪ Shovel and remove snow as needed	

Maintenance Calendar and Monitoring Checklist

DECEMBER - GENERAL TASKS			
Sector	Feature Type/Area	Maintenance Action	Task Completed
Olmsted park North: Leverett Pond/Daisy Pond	Park Furniture Level I	<ul style="list-style-type: none"> ▪ Note areas that have damaged trash barrels, benches, light poles and signage and schedule replacements. 	
	Structures Level I	<ul style="list-style-type: none"> ▪ Monitor structures for storm damage ▪ Small, routine in house repairs done within 3-5 working days. Contracted repairs assessed within 3-5 working days. 	

Appendix B: LANDSCAPE MAINTENANCE SPECIFICATIONS – CHARLESGATE

SECTION 02950
LANDSCAPE MAINTENANCE

PART I - GENERAL

1.01 SCOPE OF WORK

- A. The Limit of Work of the one-year Maintenance Period shall be the Limit of Work Line of the Contract as shown on the Contract Documents. These limits shall be staked by the Contractor for the Engineer's approval, especially near the Richardson Bridge and at Storow Drive, to establish the official limit of maintenance under this Section of the Specifications.
- B. The two-year lawn maintenance shall include, but is not limited to the following: reseeding, mowing, watering, weeding, edging, fertilizing, rolling, aeration, disease and pest control, weed control, soil testing and leaf and litter pick-up. Areas of lawn that dieback during the two-year period shall be reseeded if originally seeded as directed by the Engineer.
- C. The two-year plant maintenance shall consist of keeping the plants in a healthy growing condition and shall include watering, weeding, disease and pest control, pruning, cultivating, mulching and removal and replacement of dead material with equivalent plants. The work shall also include removal of litter and trash from planting beds.
- D. The two-year maintenance shall include maintenance of pathways, sidewalks, and stonedust surfacing areas to keep them in good condition and shall include removing and legally disposing of debris, leaves, and litter, general maintenance of paving, replenishing and compacting stonedust, and replacing or repairing paving surfaces in kind as required. The work shall not include snow removal.
- E. The two-year maintenance shall include maintenance of the waterway including removal of trash and debris from the Muddy River.
- F. The two-year maintenance shall include maintaining and/or replacing erosion control at catch basins within the stonedust surfacing areas.
- G. Plants that are dead or show obvious decline or loss of 5% of healthy growth during the either the first or second year of the two-year maintenance period, shall be removed and replaced with plants of equal size, unless designated otherwise in writing by the Owner. All replacements shall be plants of the same kind and size specified in the PLANT LIST and all costs shall be borne by the Contractor, except for possible replacements due to vandalism, theft or neglect on the part of others.
- H. The following items of related work are specified and included in other Divisions and Sections of the Specifications:
 - 1. Division I - General Requirements
 - 2. Section 01025 - Measurement and Payment
 - 3. Section 01046 - Control of Work

4. Section 01110 - Environmental Protection Procedures
 5. Section 01300 - Submittals
 6. Section 01562 - Dust Control
 7. Section 02270 - Erosion and Sedimentation Control
 8. Section 02901 - Miscellaneous Work and Cleanup
 9. Section 02915 - Traffic Controls for Construction and Maintenance
 10. Section 02930 - Lawns
 11. Section 02940 - Planting
- I. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.
 - J. Examine Section 01046 CONTROL OF WORK, herein, for Limitation of Operations, which specifically limits work that impacts public street on specific dates and times.
 - K. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
 - L. Contractor shall comply with the "Order of Conditions Massachusetts Wetlands Protection Act, G. L. c. 131, S. 40, Requirements of Submittals and Signage".
 - M. Contractor shall comply with the requirements of Section 01015 PROJECT PERMITS, herein, for all permit requirements.
 - N. At the completion of the Two-year Maintenance Period the Contractor shall meet with the Metropolitan District Commission (MDC) maintenance staff to review the maintenance procedures and to discuss specifics of plant maintenance.

1.02 SUBMITTALS

- A. Samples: Prior to ordering the below listed materials, submit representative samples to Landscape Architect for selection and approval in accordance with requirements of GENERAL REQUIREMENTS as follows. Do not order materials until Landscape Architect's approval has been obtained. Delivered materials shall closely match the approved samples.
 1. Screened Loam: The Contractor shall provide representative samples for testing and approval. Two test samples of ten (10) pounds each shall be taken and analyzed from each potential loam source. Contractor shall deliver samples to testing laboratory, have testing report sent directly to the Landscape Architect and pay all costs. Report shall be submitted at least one month before any loam is brought on to the site.
 - a. Mechanical and chemical analysis shall be by a public extension service agency and/or a certified private testing laboratory in accordance with the current "Standards" of the Association of Official Agriculture Chemists.
 - b. Soil test report shall include a mechanical sieve analysis with soil classification. Organic content shall be reported. Chemical analysis shall include pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron and Sulfate.

- c. Test report shall clearly recommend appropriate application of limestone, fertilizer, organic matter or other soil additives required.
 2. Pine Bark Mulch: Submit one cubic yard sample.
 3. Soil testing: Submit test results and product literature for the recommended treatment.
 4. Fertilizer: Submit one (1) sample packet of fertilizer and a certificate showing composition and analysis for fertilizer.
 5. Lime: Submit a certificate showing composition for lime.
 6. Disease and pest controls: Submit test results and product literature for proposed use of chemical applications.
 7. Weed controls: Submit test results and product literature for the proposed use of chemical applications.
 8. Legal disposal or storage of materials: Provide notarized copies of agreements between the Contractor and owners of land used as disposal or storage areas.
 9. Aeration methods: Submit proposed method (s).
- B. Storage and Spill Prevention Plans: Contractor shall submit a Storage Plan and a Spill Prevention Plan for on site storage of materials and equipment. Refer to Contract Documents for approved locations for storage and for site access.
- C. Certification: Submit Certification of license/certification for the Arborist.
- D. Certification: Submit manufacturer's certified analysis for standard products. Submit certified analysis by a recognized laboratory made in accordance with methods established by the Association of Official Agricultural Chemists for other materials.
- E. Schedule for plant tagging: At least ten days prior to the expected replanting date, the Contractor shall request, in writing, that the Engineer/Landscape Architect provide a representative to select and tag stock to be replanted.
- F. Schedule of Work: Prior to starting the work of maintenance the Contractor shall submit the following to the Engineer/Landscape Architect for Landscape Architect approval:
1. Schedule for Maintenance including yearly, weekly, and daily tasks;
 2. Business (Maintenance) Plan for implementing maintenance;
 3. Staffing and Equipment Plan including timed and untimed tasks, crew categories and staffing;
 4. Equipment requirements; and
 5. Dress code requirements for employees.
- G. Weekly Maintenance Reports: Prior to starting the work of maintenance the Contractor shall submit the following to the Engineer/Landscape Architect for approval:
1. Form for Weekly Maintenance Log which shall cover all maintenance categories specified herein; and
 2. Submission of Weekly Maintenance Logs detailing all work performed.
- H. Reports: During the Two-Year Maintenance Period the Contractor shall submit the following reports to the Engineer/Landscape Architect for approval:
1. General Yearly Report on Plant Health: Submit annually by October 1st.

2. Reports of inspection by certified Arborists for pruning: Submit in the spring (by March 1st) and fall (by October 1st) each year.
3. Reports of inspection for plant replacements and/or resetting of plant materials: Submit monthly reports by the 15th of each month May 15th through September 15th.
4. Reports of inspection of planting areas for weeds and invasives in general: Submit three times per year by the 15th of May, July, and September. Submittal shall identify weeds and appropriate treatment including any chemical applications with timing and rates.
5. Reports of inspection of plants for disease and pests: Submit three times per year by the 15th of May, July, and September. Submittal shall identify disease and/or pests and appropriate treatment including any chemical applications with timing and rates.
6. Report on pathway, sidewalk and stonedust surfacing areas: Submit a yearly report by September 1st.
7. Written requests for approval to aerate lawns: Submit yearly by April 15th.
8. Written requests for approval to roll lawns: Submit yearly by April 15th.
9. MEPA Annual Update Report: Submit to the Owner by October 1st a yearly compilation of all yearly reports required for MEPA compliance. Consult with Owner for report submittals required for the MEPA submittal.

1.03 CERTIFICATE OF ACCEPTANCE AND GUARANTEE FOR REPLACEMENT PLANTS AFTER COMPLETION OF THE TWO-YEAR MAINTENANCE PERIOD

- A. Following completion of both the first year of the two-year maintenance period, the Contractor shall request the Landscape Architect in writing for a formal inspection. If plant materials are in acceptable condition after the first year, written notice will be given by the Landscape Architect to the Contractor stating that the maintenance period shall continue into the second year.
- B. Following completion of the second year of the two-year maintenance period, the Contractor shall request the Landscape Architect in writing for a formal inspection. If plant materials are in acceptable condition after the second year, written notice will be given by the Landscape Architect to the Contractor stating that the maintenance period is complete.
- C. When inspection is made by the Landscape Architect at the end of both the first year and the second year of the two-year maintenance period, any plant required under this contract that is dead or unsatisfactory shall be removed from the site and replaced. Each plant shall show at least ninety-five (95%) percent healthy growth and shall have the natural character of a plant of its species in accordance with the American Nurserymen's Association Standards. All replacements shall be plants of the same kind and size specified in the PLANT LIST and all costs shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.
- D. Dead or unsatisfactory plants replaced after the second year of the two-year maintenance period is complete shall be replaced during the normal planting season, until the plants live through two years. Upon a written request by the Contractor the Landscape Architect shall make a final inspection for acceptance after the replacements have lived through two years.

1.04 EXAMINATION OF CONDITIONS AND DOCUMENTS

- A. All areas to be maintained shall be inspected by the Contractor before starting maintenance work and any defects shall be reported to the Engineer prior to beginning this work. The commencement of the work of maintenance by the Contractor shall indicate his acceptance of the condition of the site and the areas to be maintained and that the Contractor has assumed full responsibility for the work of this Section.
- B. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including, but not limited to, the potential need for storing materials, maintaining replacement plants temporarily and/or rehandling replacement plants prior to final installation.

1.05 QUALITY ASSURANCE

- A. Contractor must be knowledgeable of National Arborist Association standards and have at least five (5) years' experience involving this scale and type of work. The Contractor shall be an experienced and qualified landscaping contractor employing experienced workmen under the full-time supervision of a qualified foreman with a minimum of five years experience on projects similar in scale to this one. In addition the Contractor shall employ a licensed/certified Arborist in the Commonwealth of Massachusetts for this project. Submit license/certification for Arborist for approval by Engineer.
- A. Subcontractor Qualifications: If landscaping work is assigned to a Subcontractor the Subcontractor shall be an experienced and qualified landscaping subcontractor employing experienced workmen under the full-time supervision of a qualified foreman with a minimum of five years experience on projects similar in scale to this one. In addition the Subcontractor shall employ, for this project, a licensed/certified Arborist in the Commonwealth of Massachusetts. Submit license/certification for Arborist for approval by Engineer.
- B. Contractor shall establish an employee dress code with all employees outfitted with uniforms. Submit proposed dress code to the Engineer for approval.

1.06 MAINTENANCE OF EQUIPMENT AND ON SITE STORAGE OF MATERIALS

- A. Equipment necessary for this contract shall be properly maintained and in good operating condition to the Engineer's satisfaction. The Contractor shall promptly remove and replace equipment, which the Engineer deems to be in unsatisfactory repair or condition or otherwise unsuitable.
- B. Vehicles shall display prominently the Contractor's name, address, and telephone number on both doors. No personal vehicles shall be allowed on the project area. No equipment or vehicles shall be left overnight on the project area.

- C. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from damage, injury and theft. No materials shall be left overnight on the project area.
- D. Based on the Order of Conditions Massachusetts Wetlands Protection Act G.L.c. 131, 5.40 the Contractor shall submit a Storage Plan and Spill Prevention Plan for approval of the Engineer. No material shall be brought on to the site until approval of the Storage Plan and Spill Plan.
- E. Storage shall be outside the one hundred (100') foot Water Resource Line and shall occur in areas designated on the Drawings or approved by the Engineer in the field.
- F. No equipment or unconsolidated material shall be stored in the twenty-five (25') foot Riparian Zone or over the water. Any equipment used in the Wetland Resource Area or Riparian Zone that uses fuel, oil, and/or hydraulic fluid shall be inspected daily for leakage.
- G. Any such equipment requiring repair shall be repaired outside of the Wetland Resource Area and the Riparian Zone. Any equipment that uses fuel, oil, and/or hydraulic fluid shall be manned at all times while operational within the Wetland Resource Area or Riparian Zone.
- H. No materials shall be stored within the driplines of existing trees to remain or trees planted under this Contract.

1.07 PROTECTION OF EXISTING CONDITIONS AND MAINTENANCE OF PLANT PROTECTION FENCING

- A. The Contractor shall see that throughout maintenance operations all necessary measures are employed by him to prevent any damage to the site during his maintenance operations. This shall include, but shall not be limited to the following: the water edges, river banks, existing trees, shrubs and ground cover, or existing paving, furnishings and utility systems on the site and outside of the limits of the site.
- B. Fence for protection of planting areas installed under Section 02940 PLANTING, herein, shall be maintained in place during the two-year maintenance period. The protection fence shall be maintained in good condition and shall be repaired or replaced, if beyond repair, as required during the two-year maintenance period at no increased cost to the Owner.
- C. Protection fence shall be removed in its entirety after the two year maintenance period is complete, but only after written approval to remove it has been issued by the Engineer/Landscape Architect. Contractor shall protect the plantings removal from any damage during the fence.
- C. Should any damage occur to the above planting due to Contractor's lack of diligence in maintaining fence in good condition or during the removal of the fencing the Contractor shall bear the full cost of replacement of plant materials to the satisfaction of the Owner. All plant replacements shall be in accordance with the original contract installation. All

restorations shall be in kind and shall be approved by the Engineer/Landscape Architect and the Owner.

1.08 SAFETY

- A. All equipment to be used and all work to be performed must be in full compliance with all standards as promulgated by OSHA at the time of bidding, including, but not limited to those regulations concerning noise levels, protective devices and operator safety.
- B. The Contractor shall be solely responsible for pedestrian and vehicular safety and control within the worksite and shall protect the public and its property from injury or damage that could be caused by the progress of the work. To this end the Contractor shall post work areas, provide police details and/or erect and maintain protective devices as necessary to the Engineer's satisfaction, including but not limited to, barricades, lights and warning signs.
- C. Any practice employed by the Contractor, which is obviously hazardous as determined by the Engineer shall be immediately discontinued by the Contractor upon receipt of either written or oral notice from the Engineer to discontinue such practice.

1.09 MANNER OF CONDUCTING THE WORK

- A. The work shall be conducted with prime consideration given to the following:
 - 1. Compliance with Americans with Disabilities Act requirements.
 - 2. Compliance with governing laws and building codes.
 - 3. Safety, protection, and convenience of the public and workmen.
 - 4. Protection of the existing building structure, materials and finishes from damage.
 - 5. Minimization of dirt and dust proliferation.
 - 6. Avoidance of any damage to vegetation.
 - 7. Maintenance of existing site drainage and drainage structures and protection of structures from siltation during construction.
 - 8. Provide unobstructed legal exits and entrances at all times.
- B. All work shall be done in accordance with the governing laws and building codes and the Contractor shall procure all necessary permits required for the work, other than those provided by the Owner. Refer to Section 01015, PROJECT PERMITS, herein.
- C. The burning of trees, brush, stumps, etc., will not be permitted. The Contractor shall provide satisfactory off-site methods of disposal without additional compensation from the Owner.
- D. Upon request the Engineer shall be provided with notarized copies of agreements between the Contractor and owners of land used as disposal areas. The Contractor shall make arrangements and negotiations necessary for the satisfactory legal disposal of trees, shrubs, stumps, roots, dead-wood, boulders, debris, removals of any kind, and litter off site at no increased cost to the Owner.

1.10 REFERENCES AND STANDARDS

- A. Where references are made in these Specifications to Standard Specifications, codes, etc., of the U.S. Government, State or local authorities, or professional and industrial societies and associations, the applicable portions thereof shall govern as fully as if they were recited at length herein, and shall include all revisions thereto issued as of the date of the Notice to Contractors pertaining hereto.
- B. The following references are used herein and shall mean:
 1. ASNS: "American Standard for Nursery Stock," ASNA 260.1, latest edition, published by the American Association of Nurserymen (AAN).
 2. SPN: "Standardized Plant Names," latest edition, by the American Joint Committee on Horticultural Nomenclature.
 3. AOAC: Association of Official Agricultural Chemists.
 4. Pruning Standards: The "Standards for Pruning Shade Trees" of the National Arborist Association, 174 Route 101, Bedford, NH 03102.
 5. ASTM: American Society for Testing and Materials, latest edition.
 6. OSHA: Occupational Safety and Health Administration.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Contractor shall provide all required materials and equipment required to perform landscape maintenance as specified, herein.
- B. All plant replacements made during both the first and second year of the two-year maintenance period shall be of the same species and size specified in the original project PLANT LIST. Refer to Section 02940 PLANTING, herein, for requirements for planting. All costs of replacements shall be borne by the Contractor, except for possible replacements due to vandalism, theft, or neglect on the part of others.
- C. The Contractor shall be responsible for furnishing his own supply of water to the site at no extra cost to the Owner. Any work injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation.
- D. Fertilizer for Lawns and Plants:
 1. **Lawns:** Standard application for lawn fertilizers, three times per year minimum, shall be:

<u>Type of Fertilizer</u>	<u>Date of Application and Pounds</u>		
	<u>Applied per 1,000 Square Feet for Lawns</u>		
	<u>April 1</u>	<u>May 1</u>	<u>Sept 1</u>
20-10-5, 20-6-4 or similar analysis	5-7 lbs.	4-5 lbs.	4-5 lbs.
10-6-4, 10-5-5 or similar analysis	10-12 lbs.	10-12 lbs.	6-8 lbs.

8-6-4, 8-6-2 15-20 lbs. 10-15 lbs. 10-15 lbs.

Note: Only one of the above lawn fertilizing schedules shall be used during any one growing season.

2. **Trees and Shrubs:** High-nitrogen commercial dry fertilizers such as 10-8-6, 10-6-4, 8-6-4 and 8-6-2 shall be used for trees and shrubs. The important point is that the mix shall be a complete mix, which includes nitrogen, phosphorus and potassium.
3. Submit certification of fertilizer for Engineer's approval.

E. Liming:

1. Ground limestone shall be applied to bring lawn areas to desired 6.0-6.5 pH level. Rate of application shall be determined by soil test done on a yearly basis. Rate of application of ground limestone shall not exceed 70 pounds per 1,000 square feet at any one time, with at least 30 days between applications to bring the pH to the desired level.
2. Submit certification of lime for Engineer's approval.

F. Mulch:

1. Mulch shall be aged pine bark mulch aged a minimum of six months. The mulch shall be dark brown in color, free of chunks and pieces thicker than 1/4 inch. Mulch must be free of stringy material, and shall not contain, in the judgment of the Landscape Architect, an excess of fine particles.
2. Submit sample for Engineer's approval.

G. Weed Control for Lawns and Plants:

1. Any chemical applications recommended for control of weeds must conform to the Order of Conditions issued by the Department of Environmental Protection (DEP) and all Municipality, State, and Federal laws and regulations.
2. The proposed chemicals, the timing for control, and method application of chemicals shall be submitted to the Engineer in writing for approval. No material or method of application shall be employed on the site until the Owner has granted written approval.
3. Submit certification of proposed weed control and product literature for Engineer's approval.

H. Disease and Pest Control for Lawns and Plants:

1. Any chemical applications recommended for control of diseases and pests must conform to the Order of Conditions issued by the Department of Environmental Protection (DEP) and all Municipality, State, and Federal laws and regulations.
2. The proposed chemicals, the timing for control, and method application of chemicals shall be submitted to the Engineer in writing for approval. No material or method of application shall be employed on the site until the Engineer has granted written approval.
3. Submit certification of proposed weed control and product literature for Engineer's approval.

- I. Screened Loam: Screened loam shall meet the requirements of screened loam as specified in Section 02930 LAWNS, herein. Submit test results for Owner's approval.
- J. Planting Backfill: Backfill for planting beds taken from the planting hole and/or loam borrow and soil additives shall meet the requirements specified in Section 02940 PLANTING, herein. Submit test results for Owner's approval.

PART 3 - EXECUTION

3.01 LAWN MAINTENANCE

A. Watering:

1. The Contractor shall water as required all lawn areas to maintain adequate moisture in the upper six inches (6") of soil necessary for the promotion of deep root growth especially during the months of June, July and August and/or as required by weather conditions. Watering shall be done in a manner, which will provide uniform coverage, prevent erosion due to application of excessive quantities over a small area, and prevent damage to the finished surface.
2. Water sources for manual watering shall be a combination of yard hydrants (if available from BWSC) or watering trucks. The Contractor shall provide conventional hoses and sprinklers and/or watering trucks, at no increased cost to the Owner. Refer to Section 01046 CONTROL OF WORK, herein, for use of BWSC hydrants.
3. Materials and methods for manual watering shall be those, which encourage slow and deepwater penetration without compacting or otherwise disturbing the mulched beds or lawn surface.
4. The Contractor shall supply and maintain in good working order all hoses, sprinklers, watering trucks, safety barriers, warning signs, and other equipment and materials employed for manual watering.

B. Mowing:

1. During the spring and fall growing season when precipitation is normal grass shall be maintained at a maximum height of two inches (2") and a minimum of one and one-half inches (1-1/2"). Lawn clippings shall be removed.
2. During drought conditions or during July and August, if these months are dry, the grass shall be maintained at a maximum height of three inches (3") and a minimum of two and one-half inches (2-1/2"). Lawn clippings shall be removed.
3. Mowing and necessary trimming and edging shall be performed weekly, or when the grass is of sufficient length to produce one half-inch (1/2") of clippings.
4. Before the first mowing in the spring all debris, leaves, paper and trash that have accumulated over the winter should be picked up and removed from the property and the lawn areas shall be raked.
5. Collect litter prior to each grass cut. In areas of reduced grass cutting frequency collect the litter at least once a week between April and October inclusive

C. Soil Testing for Fertilizer and Lime Applications:

1. In the event that the lawn areas are not growing well, the Contractor shall perform soil tests in these areas to discover lime needs fertilizer requirements or potential polluting contaminants. Soil tests shall be taken in the early spring, early fall, or as required. The Contractor shall implement corrective and remedial measures as recommended by soil testing. Submit a copy of test results and recommended applications of materials to the Owner for approval prior to application.
2. Lawn fertilizer shall be applied three times per year minimum in April, May and September. Lime applications shall be either early spring or late fall, with early spring (April) being preferred.
 - a. At least fifty (50%) percent of nitrogen should be in an organic form.
 - b. Fertilizer shall be applied only when the grass is dry. After the application, the fertilizer shall be washed into the soil to prevent discoloration or burning of the grass.
 - c. If water is not available, the turf shall be brushed lightly with the back of a rake.
3. In order to determine the yearly lime and fertilizer needs, soil samples shall be taken to a depth of 3-6 inches from varying parts of the lawn on a yearly basis. If the area to be tested is of considerable size, or if it varies in texture to any marked degree, several samples shall be obtained.
4. If there is a decided variance in the general character of the soil, the samples shall be kept separate. If the soil is uniform in character, the samples may be mixed together to form a composite sample. The sample(s) shall be protected from contamination while being spread out to dry on clean paper. After the soil is thoroughly dry, it should be sent to the testing agency.
5. The soils will be tested for the following:
 - pH
 - K. Nitrogen (total)
 - Ammonium Nitrogen
 - Phosphorus
 - Potassium (Potash)
 - Contaminants
6. Soil samples shall be sent for analysis to the State Agriculture Experiment Station in Waltham, MA or a similar testing agency approved by the Owner.

D. Weed Control:

1. When weeds start to invade, the Contractor should first identify the weed and then the appropriate treatment for its removal. The Contractor shall submit in writing the identification results and proposed treatment for removal to the Owner prior to starting any removal operations.
2. Hand removal is preferred, but if chemical removal with a selective herbicide is to be considered the best timing for control shall be established and the proposed time and method application of chemicals shall be submitted to the Owner in writing for approval. Do not proceed with removal until written approval has been given by the Owner.

E. Disease and Pest Control:

1. The Contractor shall submit diseased or distressed portions of the lawn to Middlesex County Agricultural agent in Concord, Massachusetts or the University of Massachusetts Cooperative Extension in Amherst, Massachusetts for recommended spray and application. The Contractor shall submit in writing the identification results and proposed treatment for control to the Owner prior to starting any treatment operations.
2. Any chemical applications recommended for control of diseases and pests must conform to the Order of Conditions issued by the Department of Environmental Protection (DEP) and all Municipality, State, and Federal laws and regulations. The best timing for control shall be established and the proposed time and method of application of chemicals shall be submitted to the Owner in writing for approval. Contractor shall submit in writing to the Owner the chemical (s) to be used and shall be given written approval by Owner prior to proceeding with application. Do not proceed with treatment until written approval has been given by the Owner.

F. Aeration:

1. In areas subject to overuse, aeration shall be performed yearly by the Contractor. Work shall be performed at the same time that fertilizer is applied in the spring.
2. Contractor shall submit proposed equipment to be used and the method and schedule of aeration to the Owner for approval. Do not proceed with the aeration until written approval has been given by the Owner.

G. Plant Litter, Leaf Pick-up and Trash and Debris:

1. Complete plant litter pick-up and leaf removal of all lawn areas shall be done weekly.
2. Complete trash and debris removal of all lawn areas shall be done weekly.

H. Grading and Reseeding or Resodding:

1. In the spring and in the fall any bare spots and any mounds or depressions in lawn areas, which inhibit proper drainage of the area shall be regraded and repaired.
2. These areas shall be smoothly blended into surrounding grades, scarified and reseeded in areas originally seeded or resodded in areas originally sodded, both with the original seed species.

I. Rolling:

1. Lawns shall be rolled in the early spring (but not sooner than April 1) to level grass uprooted by frost action. This shall be done only after all frost is out of the ground and the soil has dried out enough so that it is not wet or soggy. Do not proceed with the aeration until written approval has been given by the Owner.
2. The roller shall weigh less than 100 pounds and shall not be used at any other time of the year.

3.02 PLANT MAINTENANCE

A. Watering:

1. The Contractor shall be responsible for watering all plants including trees, shrub beds, ground cover, and perennials as required by weather conditions. At each watering the soil around each plant shall be thoroughly saturated.
2. Water sources for manual watering shall be a combination of yard hydrants (if available) or watering trucks. The Contractor shall provide conventional hoses and sprinklers and/or watering trucks, at no increased cost to the Owner.
3. Materials and methods for manual watering shall be those which encourage slow and deep water penetration without compacting or otherwise disturbing the mulched beds or lawn surface.
4. The Contractor shall supply and maintain in good working order all hoses, sprinklers, watering trucks, safety barriers, warning signs, and other equipment and materials employed for manual watering.

B. Fertilizing:

1. Once a year in the spring, all shrubs, groundcovers and perennials shall be fertilized. Individual specimen shrubs shall be fertilized at the rate of 1/2 to 1 pound per plant, depending on the size of the plant. Groups of shrubs shall be fertilized at the rate of 2 to 4 pounds per 100 square feet of soil surface area.
2. Where shrubs are planted in a cultivated border, fertilizer applications shall be evenly broadcast on the soil surface beneath the shrubs, then lightly worked into the soil.

C. Litter and Leaf Pick-up:

1. Complete litter and leaf pick-up including fall leaf removal of all plant areas shall be done weekly.

D. Weeding and Edging:

1. Thorough inspection of all plantings for required weed control shall be done three times per year. Submit a written summary of findings and proposed treatment for Owner's approval prior to proceeding with any removal.
2. The Contractor shall first identify the weed(s) and then the appropriate treatment for their removal. Hand removal is preferred.
3. Any chemical applications recommended for control of weeds must conform to the Order of Conditions issued by the Department of Environmental Protection (DEP) and all Municipality, State, and Federal laws and regulations. The best timing for control shall be established and the proposed time and method of application of chemicals shall be submitted to the Owner in writing for approval. Contractor shall submit in writing to the Owner the chemical (s) to be used and shall be given written approval by Owner prior to proceeding with application. No material shall be used until the Owner has granted written approval.
4. Complete edging and weeding of all shrubs and all planting beds shall be done once a month or as necessary from mid-April through September. Beds shall be neat in appearance and maintained to the lines originally laid out.

E. Mulching:

1. All individual trees and shrub beds shall be mulched yearly in April. Mulch shall be a minimum of three inches in depth. Mulch shall be pine bark mulch. Submit sample to Owner for approval prior to spreading any mulch.

F. Disease and Pest Control:

1. Thorough inspection of all plantings for required disease and pest control shall be done three times per year. Diseased or distressed portions of plants shall be submitted to Middlesex County Agriculture Agent for the recommended treatment method and application. Submit a written summary of findings and proposed treatment for Owner's approval prior to proceeding with any removal.
2. Any chemical applications recommended for control of diseases and pests must conform to the Order of Conditions issued by the Department of Environmental Protection (DEP) and all Municipality, State, and Federal laws and regulations. The best timing for control shall be established and the proposed time and method of application of chemicals shall also be submitted to the Owner in writing for approval. Contractor shall submit in writing to the Owner the chemical (s) to be used and shall be given written approval by Owner prior to proceeding with application. No material shall be used until the Owner has granted written approval.

G. Pruning:

1. Plant material shall be pruned only as necessary during the two-year period. In order to determine "necessary pruning" the following procedure shall be followed.
 - a. All trees and shrubs to be pruned shall be inspected in the spring and fall by the Contractor's Arborist for any unusual safety or tree health concerns and a written report shall be submitted to the Owner which shall include proposed pruning.
 - b. After the report is submitted, the Owner or his representative and the Contractor's Arborist shall perform a site inspection of all plant material in order to determine the extent of pruning to be performed.
 - c. The Contractor's Arborist shall submit a report outlining all pruning to be performed as determined during the site visit.
 - d. The Owner shall review and approve the proposed pruning report and shall issue a work order to the Contractor's Arborist prior to the start of any work.
 - e. Upon completion of pruning, the Owner or his representative and the Contractor's Arborist shall make a site inspection again. If the work has been satisfactorily completed as determined by the Owner's Representative the Contractor's Arborist shall submit a written report to the Owner detailing the work performed and the Owner shall issue written approval of the pruning.
2. The Contractor's Arborist shall be certified by the International Society of Arboriculture. All pruning must be done in compliance with American National Standards Institute Z133 and A300 standards.
3. All pruning cuts shall be made according to ANSI A300 Section 5.2.5. No stubs shall be left nor will flush cuts be made, the branch collar shall be left intact. Severed limbs shall be removed before the end of the workday. Wound dressing shall not be applied.
4. Tree branches shall be removed in a manner, which does not damage the tree, other plants or property. Where necessary to protect the public, ropes will be used to lower large branches. Not more than 1/4 of the leaf surface of a tree shall be removed.

5. Pruning of shrubs shall include removal of all dead or broken branches and branches, which interfere with the proper development of the shrub. Broken or badly bruised branches shall be removed with a clean cut. No shrubs shall be sheered or cut into shapes. The natural character of the shrub shall be maintained and shrubs shall be pruned and shaped to maintain their natural character.

H. Plant Inspection and Replacement and/or Resetting:

1. All trees and shrubs shall be inspected monthly during the growing season by the Contractor for any unusual safety or tree health concerns or for evidence of plants that need to be replaced or need to be reset to proper grades or upright position. All dead, diseased, damaged plants, or plants that have safety issues shall be replaced as soon as planting conditions allow.. A written report shall be submitted to the Owner which shall include proposed plant replacements or resetting of material and a schedule for replacement and resetting.
2. After the report is submitted, the Owner or his representative and the Contractor shall perform a site inspection of the plant material in order to determine the extent of replacements and/or resetting required and to determine the schedule for replacement and resetting.
3. The Contractor shall submit a report outlining the schedule and providing a species list and size for all material to be replaced.. Size of all material shall conform to original PLANT LIST. Only top-quality plants shall be used.
4. The Owner shall review and approve the proposed plant replacement report and shall issue a work order to the Contractor prior to the start of any work.
5. All plant replacements shall be selected by the Owner's Representative as follows:
 - a. At least ten days prior to the expected replanting date, the Contractor shall request, in writing, that the Owner provide a representative to select and tag stock to be replanted. The Contractor shall arrange and pay for the transportation and overnight accommodations, if necessary, for the Owner's Representative during the period of time required to select and tag plant material.
 - b. The Contractor shall be responsible to certify the availability of required plants in specified sizes from his sources of supply prior to requesting the Owner's Representative to make plant source inspections. In the event that plants at the inspection location are found to be unavailable or if insufficient size, the Contractor shall be liable to reimburse the Owner for all costs of the Owner's Representative's hourly services incurred during unproductive inspection trips as well as travel expenses and overnight accommodation.
 - c. The Contractor shall be responsible for timing the delivery of materials for replanting so as to minimize on-site storage time prior to installation. Plant quantities brought to the site shall be scheduled to be planted within the work day they arrive on the site. Other materials stored on the site shall be protected from weather, careless handling or vandalism, but shall be stored for a minimum time on site. The Contractor shall comply with the "Order of Conditions Massachusetts Wetlands Protection Act, G. L. c. 131, S. 40, Requirements of Submittals and Signage" as contained in the Contract Documents.
 - d. The Contractor shall schedule plant selection and digging operations so as to comply with nursery industry recognition of 'Spring Dig Only' or "Fall Hazard" plant materials. No substitutions of plant materials will be allowed for fall planting based on unavailability due to the 'Spring Dig Only' restrictions.

6. Upon completion of plant replacement and /or resetting of plant materials, the Owner or his representative and the Contractor shall make a site inspection again. If the work has been satisfactorily completed as determined by the Owner's Representative the Contractor shall submit a written report within two weeks of replanting or resetting to the Owner detailing the work performed and the Owner shall issue written approval of the plant replacement and/or resetting.

3.03 PATHWAYS, SIDEWALKS AND STONEDUST SURFACING AREAS

- A. The area within the shadow of the elevated highway is stonedust surfacing. Pathways within the project area and City sidewalks are brick or concrete.
 1. Collect litter weekly.
 2. Soft surfacing materials i.e. stonedust shall have the material replenished and re-compacted yearly in the spring.
 3. Inspect all paving surfaces within the Contract Limit Line yearly and repair or replace as required. All replacements shall be in-kind.

END OF SECTION

Appendix C: HISTORIC BRIDGE RESTORATION SPECIFICATIONS

SECTION 04500

HISTORIC MASONRY RESTORATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

This section specifies the following items required to complete the restoration of stone masonry. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, Specification sections, apply to the Work of this Section.

- A. This includes the 100% removal and repointing of all mortar joints, not otherwise treated, on the spandrel faces of the arches and all parapet and bridge wing walls on each of the individual bridges to a depth of 2.5 times the joint width or a minimum of 1", or to sound mortar, whichever is greater. Repoint all walls to a depth of 8" below the present ground line.
- B. On the underside of the arches of the Chapel Street, Bridle Path and Cove Bridges, repoint the deep split between the stone spandrel walls and the brick arch elements with a soft mortar. Color to match adjacent brick mortar. Exact mix to be determined in field in consultation with the Engineer. The repointing of this location is included under the work covered by this item and the base bid of the contract. This work is not to be construed to be part of the add alternate.
- C. All masonry restoration shall be consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties. A copy of these standards are attached to this section.
- D. The Contractor must take care to protect all existing historic fabric from damage.
- E. Removal of any debris shall be done in such a way as to minimize the impact on surrounding historic fabric.
- F. Replace missing and/or mis-matched stones with new stones to match the color texture, grain size, surface finish and profiles of the existing historic stone work. Replace 50 linear feet of coping stone on the Bridle Path Bridge, selectively replace and/or relocate coping and wall stones as called for on the drawings.
- G. Develop and follow a documentation plan to ensure that all rebuilt areas will exactly match the original stone configuration.
- H. Extend existing holes in the Chapel Street Bridge coping stones and spandrel wall to a depth of 6" below underside of stones for installation of refurbished railing with extended posts.
- I. Epoxy repair all cracked or broken stone to be reused.
- J. Note that the Contractor shall verify and be responsible for field survey of all quantities and measurements called for and/or noted

in the Contract Documents. The Contractor or masonry sub-contractor shall notify the Engineer in writing, at least seven days prior to the bid due date of any variation from the quantities called for. In the absence of such notification, the Contractor, by submitting their bid, certifies agreement with and acceptance of the quantities called for.

- K. If additive alternates are accepted, repoint the brick masonry and replace missing/damaged brickwork on the underside of the arches, to the quantities called for in the alternative description.

1.2 RELATED WORK

- A. 04510 - HISTORIC MASONRY RESTORATION CLEANING
- B. 05500 - MISCELLANEOUS METALS

1.3 QUALITY ASSURANCE

- A. The Contractor or sub-contractor (whoever is directly responsible for the execution of the work under this section) shall have not less than five years experience restoring historic stone masonry.
- B. The Contractor or sub-contractor shall be certified by the Commonwealth of Massachusetts, Division of Capital Planning and Operations for Historic Masonry.

1.4 SAMPLE PANELS

- A. Field-Sample Panels: Prior to start of general masonry restoration, two (2) separate field sample panels shall be prepared to demonstrate; cutting and removal of existing mortar and, repointing. Undertake sample panels where directed by the Engineer. These may be done in the area where the test cleaning panels have been completed. Notify Engineer at least one week prior to beginning of work, so that they may be present to observe test panels. Obtain approval of cutting materials, methods, equipment and practices prior to commencement of mortar removal work. Review mortar materials, mixes and methods as well as mortar finish color and joint detailing. Allow sufficient time for curing of mortar in this review process. No additional work shall be performed without prior written approval of test panels. Retain acceptable panels in undisturbed condition, suitably marked, during construction as a standard for judging work.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturers' technical data for each product indicated including recommendations for their application and use. Include test reports and certifications substantiating that products comply with requirements.

- B. Restoration Process: Submit written program for each phase of the restoration process including protection of surrounding materials. Describe in detail materials, methods, and equipment to be used for each phase of restoration work.
- C. Submit to the Engineer for review and approval a written plan to document the configuration of the existing masonry to ensure rebuilt masonry sections match existing coursing etc. Do not begin dismantling or rebuilding until all procedures and methods have been reviewed and accepted.

1.7 SCAFFOLDING, STAGING AND HOISTING

- A. Comply with all safety regulations and requirements regarding scaffolding, hoisting and staging.
- B. Move stones only using nylon slings or padded tools to keep from damaging or staining existing stone masonry to remain.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.
- B. Protect mortar and other materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.
- C. Store stone off ground, properly blocked and supported to avoid damage or staining to the stone during storage.
- D. Restore any damage to site caused by storage, mixing or construction work.

1.9 PROJECT CONDITIONS

- A. Do not repoint mortar joints or repair masonry unless air temperatures are between 40 degrees F (4 degrees C) and 80 degrees F (27 degrees C) and will remain so for at least 48 hours after completion of work.
- B. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Immediately remove grout and mortar in contact with masonry and other surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone: All stone shall match the existing in grain size, color and color dispersion, texture, overall appearance and shall be indistinguishable from the original at a distance of 15 feet.

1. Stone for walls shall be seam faced Cape Anne Granite available from Johnson's Quarry Inc., 68 Johnson Road, Rockport, MA 01966.
Tel: (508) 546-1002 or approved equal.

2. Stone for cap stones shall match the existing stone identified as Cape Anne Pink. The current source of this material is unknown. Match existing material to remain meeting the criteria outline above..

A. Brick: All new brick shall match the existing brick that it is intended to replace in face dimension (size), color and surface texture.

B. Ironspot Brick shall be a custom size similar to modular Belden Brick 470-479 Light Range A, Made at Sugar Creek Plant 4, actual brick will have to be culled from the range to match the uniform color or the brick arch.

C. Red Brick: Shall match the existing brick arch that it is intended to replace in face dimension (size), color and surface texture.

D. Portland Cement: C 150, Type I, Type II or Type III as needed to match existing color.

E. Hydrated Lime: ASTM C 207, Type S.

F. Mortar Aggregate: Natural sand selected to produce mortar color match after repointing and cleaning.

G. Match size, texture and gradation of existing aggregate.

H. Grading of Sand for Stone Mortars.

I. Sieve	Bedding Mortar % Passing	Pointing Mortar % Passing
4.75 mm (#4)	97	96
2.36 mm (#8)	83	81
1.37 mm (#16)	58	50
600 um (#30)	28	21
300 um (#50)	7	8
150 um (#100)	0	1

The aggregate taken from the test samples will be provided to the successful bidder to assist them in matching the correct stone masonry mortar.

- b) Sand color for Brick Mortar: Shall be determined by the Engineer in the field. Contractor will be required to pay for any laboratory test that may be required to break down the mortar for further assessment.

F. Coloring Agents: by Frank Davis, True Tone or equal.

G. Water: Potable, clean, free of oils, acids, alkalis and organic matter.

H. Cleaner: Approved manufacturer's Detergent Masonry Cleaner.

I. Stone Anchor Pins

Fabricate anchors and dowels from AISI Type 304 stainless steel. Anchors to be set in existing stone as indicated on the Drawings. Submit sample of steel to Engineer within one week of award of bid.

Wire Pins shall be Dur-O-Wall 9 gauge stainless steel.

J. Epoxy Materials

Stone Repair Epoxy: Epoxy for stone repair or adhesion of stone fragments at non-visible contact surface areas shall be Sikadur 23, Lo-Mod Gel mixed with stone materials as indicated on the Drawings.

Other materials: Furnish all labor, services, equipment, and furnish and install all materials required to reconstruct the areas indicated on the Drawings and Specification.

2.2 MORTAR MIXES

A. General:

B. Measurement and Mixing: Measure cementitious and aggregate material (sand) in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials (sands) together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1 to 2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within 30 minutes of final mixing; do not re-temper or use partially hardened material.

C. No admixtures of any kind shall be used in the mortar.

D. Mortar Mix and Proportions:

1. The intent of the masonry work is to replace the existing masonry joint with an historically detailed, accurate and properly engineered mortar joint. The repointing work shall be completed within the chiseled margins of all stones. No finish mortar is to spread onto the face of the chiseled margins of any of the rock faced stones at the completion of the work.
2. Mortar Mix Proportions for Brick and Stone Masonry

1 part cement / 1 part hydrated lime / 6 parts sand

PART 3 - EXECUTION

3.1 GRANITE REPOINTING

1. Aesthetic Effect: Remove existing pointing mortar. Do not damage in any manner the existing granite blocks. No finish mortar is to spread onto the rock face. Depending on location, joints are to be struck off smooth or receive a vine joint. All are pitched to shed water.
2. Do no repointing until Engineer has reviewed and approved preparation work and samples in each area. Schedule work so as to minimize number of inspection visits by having large areas ready for inspection.
3. Rake out mortar joints to a depth equal to 2.5 times the joint width but not less than 1" nor less than that required to expose sound, un-weathered mortar.
4. Remove mortar from all stone surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum or flush joints to remove dirt and loose debris.
5. Cut out old mortar by hand with chisel and mallet. Small hand-held power tools may be used if, and only if, all specified criteria are met. Do not spall edges of masonry units or widen joints. Protect all surfaces. . As specified herein, all work including the use of power tools by individual workmen must be approved by the Engineer in the sample panels prior to the actual commencement of the work. If stone or brick are damaged by power tools, the use of power tools shall stop and all remaining mortar shall be done by hammer and chisel.
6. Mortar Installation: Joint surfaces are to be damp but free of standing water. Fill joints solidly with mortar in layers approximately equal to joint thickness, installing successive layers as soon as previous layers are thumb-print hard. Step back layers at daily terminations to avoid full depth joint

when following work is done. Tool finish surface of joint solid, matching profiles of original joints. Take special care to reproduce joint system under which joints are raked back slightly recessed.

7. After mortar has set sufficiently to prevent damage, clean masonry facing with burlap, stiff bristle brushes and water. No mortar shall remain on granite. Expose aggregate to give appropriate weathered appearance to the new mortar joints.
8. Cure mortar by maintaining in a damp condition for not less than seven (7) days.

3.2 REPAIR OF STONE ELEMENTS

1. The following Work shall be performed by a company or individual having at least 5 years of experience in stone conservation:
2. Re-adhesion of Separated Elements Repair:
3. Remove cracked elements at specific areas to be repaired as indicated on the Drawings and Specification. Mask at least 6" on either side of and joint to be epoxied.
4. Place Stone Repair Epoxy in pin holes and on contact surfaces. Apply a very light coating of epoxy such that no epoxy occurs within 1/4" of the crack visible surface in the final repair. Secure the stone elements and pins in place. Use only light hand pressure to make the contact surfaces join. If any epoxy reaches the visible surface of the crack, remove excess and immediately apply ground Granite dust to the joint. The joint within 1/4" of the surface shall be sealed and the stone mixtures indicated on the Drawings.

3.3 REBUILDING

- 1 Allowable tolerances: Variation from plumb: 1/8" from top to bottom of wall.
2. Variation from level: plus or minus 1/4 " along entire length of wall.
3. Erect wall with joints having uniform width and accurately aligned. Do not set units above until mortar below has set sufficiently to maintain alignment and prevent extrusion.
4. Butter all joints fully; leave no voids in the work.

3.4 FINAL CLEANING

1. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low pressure. Do not use Muriatic acid or other harsh cleaners. Use approved manufacturer's Detergent Masonry Cleaner to etch excess lime and cement and to expose aggregate at surface.
2. Use of metal scrapers or brushes will not be permitted.

4.1 PROPOSED ADDITIVE ALTERNATES

- A. General: Following is a description of the work required under the proposed ADDITIVE ALTERNATES. All work shall be done in accordance with this specification, the other specifications, and the plans.
- B. Removal of excess lime putty on arch underside: Manually remove excess lime putty using chisel and mallet to breakdown areas of 1/8 inch and greater build-up. Other mechanical and abrasive means will not be permitted.
- C. Removal of calcium deposits on arch underside: Remove all calcium deposits and dirt build-up, wash all brick and stone on the underside of the brick arch with two applications of Lime Putty Remover and one application of Heavy Duty Restoration Cleaner (3 to 1 dilution).
- D. Repointing of entire brick and stone arch underside: Repoint 100% of brick and stone arch. Joints may be cut by approved mechanical means.
- E. Repointing of entire brick and stone arch underside: Selective replacement of missing or damaged brick on arch underside at the locations indicated by and as directed by the Engineer. Approximate quantities of selective replacement for each bridge are:

Chapel Street Bridge:	70 s.f.
Bridle Path Bridge:	70 s.f.
Cove Bridge:	55 s.f.
Brookline Ave. Bridge:	10 individual bricks

END OF SECTION

**The Secretary of the Interior's Standards.
for the Treatment of Historic Properties
1992**

**U. S. Department of the Interior
National Park Service
Preservation Assistance Division
Washington, D.C.
October, 1992**

Preservation is defined as the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project.

Standards for Preservation

1. A property shall be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property shall be protected and, if necessary, stabilized until additional work may be undertaken.
2. The historic character of a property shall be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property shall be avoided.
3. Each property shall be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features shall be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
4. Changes to a property that have acquired historic significance in their own right shall be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
6. The existing condition of historic features shall be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires repair or limited replacement of a distinctive feature, the new material shall match the old in composition, design, color, and texture.
7. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
8. Archeological resources shall be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.

Rehabilitation is defined as the act or process of making possible an efficient compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values.

Standards for Rehabilitation

1. A property shall be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property shall be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property shall be avoided.
3. Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, shall not be undertaken.
4. Changes to a property that have acquired historic significance in their own right shall be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and, where possible, materials. Replacement of missing features shall be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
8. Archeological resources shall be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.
9. New additions, exterior alterations, or related new construction shall not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and shall be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction shall be undertaken in a such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Restoration is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

Standards for Restoration

1. A property shall be used as it was historically or be given a new use which interprets the property and its restoration period.
2. Materials and features from the restoration period shall be retained and preserved. The removal of materials or alteration of features, spaces, and spatial relationships that characterize the period shall be not be undertaken.
3. Each property shall be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate and conserve materials and features from the restoration period shall be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
4. Materials, features, spaces, and finishes that characterize other historical periods shall be documented prior to their alteration or removal.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize the restoration period shall be preserved.
6. Deteriorated features from the restoration period shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and, where possible, materials.
7. Replacement of missing features from the restoration period shall be substantiated by documentary and physical evidence. A false sense of history shall not be created by adding conjectural features, features from other properties, or by combining features that never existed together historically.
8. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
9. Archeological resources affected by a project shall be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.
10. Designs that were never executed historically shall not be constructed.

Reconstruction is defined as the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.

Standards for Reconstruction

1. Reconstruction shall be used to depict vanished or non-surviving portions of a property when documentary and physical evidence is available to permit accurate reconstruction with minimal conjecture, and such reconstruction is essential to the public understanding of the property.
2. Reconstruction of a landscape, building, structure, or object in its historic location shall be preceded by a thorough archeological investigation to identify and evaluate those features and artifacts which are essential to an accurate reconstruction. If such resources must be disturbed, mitigation measures shall be undertaken.
3. Reconstruction shall include measures to preserve any remaining historic materials, features, and spatial relationships.
4. Reconstruction shall be based on the accurate duplication of historic features and elements substantiated by documentary or physical evidence rather than on conjectural designs or the availability of different features from other historic properties. A reconstructed property shall re-create the appearance of the non-surviving historic property in materials, design, color, and texture.
5. A reconstruction shall be clearly identified as a contemporary re-creation.
6. Designs that were never executed historically shall not be constructed.

SECTION 04510

HISTORIC MASONRY RESTORATION CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

The general provisions of the Contract, including General and Supplementary Conditions, and relevant sections of these Specifications, apply to the work specified in this Section.

- A. It is the intent of this section to provide for the removal of all atmospheric dirt, staining and graffiti on the Riverway Bridges without harm to the existing stone. Wherever possible use cleaning agents designed to remove specific stains or coatings. All cleaning treatments shall be undertaken using the gentlest means possible.
- B. After completion of the graffiti and paint removal on Cove Bridge, coat with Graffiti Control as per manufacturers published instructions.
- C.. All restoration cleaning shall be consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties. A copy of this document is attached to the end of Section 04500.
- D.. The Contractor must take care to protect all existing historic fabric from damage.
- E.. Prevent chemical cleaning agents used in repointing and repair work from staining face of surrounding masonry and other surfaces. Do not allow unacceptable effluent to run-off into the river. Neutralize in place prior to rinsing. Contain and neutralize all runoff from cleaning operations. Where cleaning takes place over ground, agricultural lime spread over the affected may be acceptable. Provide all required, appropriate and proper protection for persons, property wetlands and adjacent watercourses.
- F.. Prior to commencement of masonry cleaning operations contractor shall submit to the engineer a written plan for environmental protection in conjunction with the cleaning operation. Work to commence only after written approval by the engineer of the proposed protection plan.
- G.. Note that the Contractor shall verify and be responsible for field survey of all quantities and measurements called for and/or noted in the Contract Documents. The Contractor and Sub-contractor shall notify the Project Engineer in writing, at least seven days prior to the bid due date of any variation from the quantities called for. In the absence of such notification, the Contractor, by submitting its bid, certifies agreement with and acceptance of the quantities called for.

1.02 RELATED WORK

- A. 04500 - HISTORIC MASONRY - REPOINTING

1.05 INTENT

- A. The intent of the work of this section is to clean masonry surfaces using the gentlest materials and techniques possible which produce an acceptable degree of cleaning. It is understood that some surfaces will not be fully cleaned by these methods and, when approved by the Engineer, will remain incompletely cleaned.

1.04 QUALITY ASSURANCE

- A. The subcontractor shall have not less than five years experience cleaning historic masonry.
- B. The subcontractor shall be certified by the Commonwealth of Massachusetts, Division of Capital Planning and Operations for Historic Masonry.

1.05 SAMPLE CLEANING PANELS

- A. Field-Sample Panels: Prior to start of general masonry restoration, prepare a sample cleaning panel to demonstrate use of proper materials and methods for masonry cleaning. Undertake sample panels where directed by the Engineer. Notify Engineer at least one week prior to beginning of work, so that they may be present to observe test panels. Allow sufficient time for complete and proper drying in this review process. No additional work shall be performed without prior written approval of test panels. Retain a portion of acceptable panels in undisturbed condition, suitably marked, during construction as a standard for judging work.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations, and recommendations for each material used.
- B. Work Program: Submit written program for each phase of the work, including protection of surrounding materials and property. Describe in precise detail all materials, equipment, solutions, concentrations, and techniques to be used. Program shall duplicate procedures used to make accepted mockups and test panels.
- C. Environmental Regulations: In written program, describe testing, handling, containment, collection, transport, disposal and discharge of hazardous materials to be cleaned. Submit copies of local environmental regulations.

- D. Protection: In written program, describe methods for protecting surrounding areas, the Muddy River, landscaping, pedestrians, vehicles, and non masonry surfaces during the work from contact with chemical restoration cleaners, residues, rinse water, fumes, wastes and cleaning effluents.
- E. Surface Preparation: In written program, describe surface preparation to be completed prior to application of restoration cleaners.
- F. V.O.C. Certification: Submit certification that the coatings used on this project comply with all regulations controlling the use of volatile organic compounds (VOCs).

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with the manufacturer's instructions and recommendations. Protect from all damage.

1.08 PROJECT CONDITIONS

- A. Weather: Perform work only when temperature of air and surfaces to be cleaned are between 50 degrees F and 80 degrees F and forecasted temperature is expected to be 40 degrees F or above for at least one week after cleaning. Weather conditions shall also be within the limits established by manufacturers of the materials and products used if more restrictive than specified in this section.
- B. Protection: Protect persons, property, motor vehicles, non-masonry surfaces, the site and the Muddy River from injury or damage due to Contractor's operations. Do not clean during windy weather. Dispose of runoff from cleaning in a legal manner which does not cause erosion or other damage.
- C. Environmental Regulations: Comply with all State, local, and Federal environmental regulations regarding testing, handling, treatment, containment, collection, transport, disposal, and discharge of hazardous waste and cleaning effluents.

1.09 COORDINATION, SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-project conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Sequence of Work: Perform work of this section and other sections in the optimum sequence to prevent damage to or interference with other work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Materials: All cleaning products shall be from the same manufacturer. Provide cleaning products from one of the following pre-approved manufacturers:

1. ProSoCo, Inc.
2. HydroChemical Techniques, Inc.
3. Diedrich Chemical Co.

Provide masonry cleaning materials of following types as specified in the Construction Specifications.

- B. Restoration Cleaner: Provide a general purpose acidic restoration cleaner for granite and other masonry surfaces that is proven to dissolve heavy atmospheric soiling. This is the mildest cleaning agent specified.

1. Form: Clear Liquid;
2. Color: Light Amber;
3. pH (concentrate): 1.2;
4. Specific Gravity: 1.05;
5. Flash Point: None.

- C. Heavy Duty Restoration Cleaner: A single component, concentrated, acidic cleaning compound formulated as carbon solubilizer. Designed for use with high pressure, cold water rinsing to remove atmospheric dirt, carbon stain, paint oxidation, embedded clay and mud stains, algae and mold formations from existing masonry surfaces. To be used when Regular Restoration Cleaner has inadequate strength.

1. Form: Clear Liquid;
2. Color: Light Amber;
3. pH (1:3 dilution): 2.9;
4. Specific Gravity: 1.13;
5. Flash Point: None.

- D. Acid Neutralizing Rinse: Single component, alkaline based liquid. designed for use in conjunction with acidic cleaning compounds to allow for a reduction in rinse water volume or to ensure a neutralized pH for any rinse water that may flow into the adjacent watercourse. To be used, as needed, in conjunction with restoration cleaners noted above.

1. Form: Clear Liquid
2. pH: 14.0
3. Weight per gallon: 8.8 lbs.
4. Specific Gravity: 1.06

- E. Lime Putty Remover is a blend of organic and inorganic acids combined with special wetting systems and inhibitors and is designed for the effective removal of heavy lime deposits.
1. Form: Clear Liquid
 2. Specific Gravity: 1.127
 3. pH: 0.4
 4. Wt./Gal. 9.4
- F. Heavy Duty Paint Stripper is an alkaline/solvent compound designed specifically for removing multiple layers of paint from masonry surfaces.
1. Form: Light brown gel
 2. Specific Gravity: 1.056
 3. Wt./Gal. 10.8
- G. Fast Acting Gaffiti Remover dissolves most spray paints, marking pens, lacquers and other graffiti from masonry, wood and metal surfaces.
1. Form: Clear Gel.
 2. Specific Gravity: 1.220
 3. Flash Point Over 175 degrees F
 4. Weight per gallon: 10.17 lbs.
- H. Heavy Duty Graffiti Remover is a slow working, extended contact remover that remains active for 24 hours. It is effective on brick, concrete and other masonry surfaces. It contains no methanol, methylene chloride or other halogenated solvents.
1. Form: Light Brown Gel
 2. Specific Gravity: 1.270
 3. Flash Point: Over 175 degrees F
 4. pH: 14
 5. Weight per gallon: 10.6 lbs.
- I. Ink and Shadow Remover extracts deep-seated marking pen and paint shadows that remain after the use of other graffiti removal products. Part A and B are designed for job site mixing to create a smooth poultice paste suitable for trowel application.

Dry powder - Part A

Form: Powder
Specific Gravity: 0.60
Flash Point: n/a
Weight per gallon: 9.28 lbs.

Additive - Part B

Form: Liquid
Specific Gravity: 1.113
Flash Point: 16 degrees F
Weight per Gallon: 9.28 lbs.

- J. Graffiti Control is a clear, single part , high solids protective coating formulated for application to exterior masonry surfaces. The excellent chemical resistance of the coating makes it ideal for anti-graffiti applications.

1. Form: Clear
2. Specific Gravity: 0.923
3. Flash Point - 80 degrees F
4. Weight per gallon: 7.7 lbs
5. Solids 27.4%
6. Viscosity (#4 Ford): 20 seconds

2.02 MIXING

- A. Cleaning materials should be diluted to the greatest dilution possible that will still allow desired cleaning results. Refer to paragraphs A & B in Section 1.01 - Description of Work, above.

PART 3 - EXECUTION

3.01 INSPECTION

- A. The Installer shall examine conditions under which this work is to be performed and notify the Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts conditions.

3.02 PREPARATION AND INSTALLATION

- A. General Requirements: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Use products, concentrations and techniques used on approved sample panels.
- B. Protection: Protect adjacent non-masonry surfaces and areas not to be cleaned from coming in contact with chemical cleaning solutions by using strippable masking agent, plastic sheeting and waterproof tape, or another effective isolator approved by the engineer.
- C. Cleaning: Do not use wire brushes, steel wool, abrasive blasting, nor high pressure water spray (over 400 psi). Work in an orderly manner, from top to bottom and from one edge of the surface to the other. Ensure complete coverage into all corners, interstices and the like.
1. Perform work in a manner to result in uniform final appearance without streaking. Do not apply chemical solutions to one area more than twice. Do not allow chemical cleaning solutions to

dwell on surfaces for periods longer than done for mock-ups,
 nor longer than recommended by the manufacturer.

2. Thoroughly rinse off chemicals and brush off surfaces with Tampico type fiber brushes as necessary to produce uniform cleaning that matches approved sample panels.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall establish and maintain throughout the work of this section an effective quality control program to ensure that work is performed as required by the Contract Documents. Establish specific procedures to prevent chemical bleaching and damage of masonry surfaces.

3.04 FINAL CLEANING & PROTECTION

- A. Re-clean masonry surfaces after repointing, using only low pressure water and brush methods recommended by Brick Institute of America. Do not use Muriatic acid or other harsh cleaners.

END OF SECTION

SECTION 05500

HISTORIC METALS

PART 1 - GENERAL

1.01 DESCRIPTION

The general provisions of the Contract, including General and Supplementary Conditions, and all Division 1 sections of the Specifications apply to the work specified in this section.

- A. All work shall be in strict conformance with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*.
- B. Document and identify each railing section, its location and sequence prior to disassembly. Disassemble existing railing as required to allow for reinstallation in three bay sections. Review plan and schedule for documentation and removal of railing with Engineer prior to commencement of the work.
- C. The Contractor must take care to protect all existing fabric from damage during disassembly and reinstallation. Particular care must be taken to ensure the retention of the maximum amount of historic fabric possible. Completely remove all embedded ferrous elements set in lead in sleeves in the stone masonry structure. Cutting of posts and/or damage to stone from removal of lead shall not be permitted.
- D. Refurbish existing railing elements. Retain as much of the original historic fabric as possible. All new elements to match existing elements being replaced in dimension, configuration and texture.
- E. Where existing channel is severely damaged and/or missing, cut out section, weld in new metal, grind smooth, prepare and paint. Repair areas noted in the plans and assume 3 feet of additional repairs determined by the engineer after sandblasting.
- F. Fill with weld and grind smooth all defects greater than 1/8" deep and all existing welded joints.
- G. Tack weld all loose balusters.
- H. Fabricate and attach new stainless steel post extensions. For welding dissimilar materials to stainless steel use #309 rod. Coordinate to ensure proper fit with existing cap stones to remain.
- I. Install new cap similar and equal to Blum #4441 on refurbished top channel.
- J. Prepare shop drawings for all work specified in this section.
- K. Blast clean prior to galvanizing and painting.
- L. Reinstall in units of three pre-assembled sections. Install plumb, level and true. Match existing configuration.
- M. Set posts of restored railing in epoxy to within 1-1/2" of the top of the granite coping stones. Finish last 1-1/2" with poured lead or lead wool hammered tight and pitched to shed water away from the posts.

1.02 QUALITY ASSURANCE

- A. The Iron Restoration Contractor shall have at least five years of documentable experience with historic work of comparable size and complexity. This specialist shall have successfully completed a minimum of three comparable wrought iron restoration projects on National Register Historic Properties within the last five years.
- B. The Contractor shall submit to the Engineer a description of these three projects including name, address, current telephone numbers of the Engineers and Owners.

1.03 SUBMITTALS

- A. Submit to the Engineer for concurrence a written plan and schedule for removal and reinstallation of historic railing. This plan will include a description of how the existing railing, set in lead joints, will be removed without cutting of posts or damage to the existing cap stones. It will also include a description of shop cleaning and repair methods. Describe the particular care required to install and reassemble the railing in place and any touch-up to be employed.
- B. Submit shop drawings for all metal fabrications called for herein or on the drawings.
- C. Prior to submission of the Shop Drawings to the Engineer, they shall be pre-checked by the Contractor for conformity of detail with the Contract Documents and existing conditions and as coordinated with other work under his charge. The signature of a representative of the Contractor indicating that the drawings have been pre-checked will be required. The Contractor shall be wholly responsible for the conformity of dimensions and details of the Shop Drawings with the Contract Documents.

Shop Documents shall be submitted prior to fabrication.

- D. Historic Metals Contractor shall submit a 12+ foot section (three panels) of restored railing as a demonstration of workmanship and finish. After acceptance of restored and painted sample, the sample shall be used as a quality standard for judging all other related work.

1.04 RELATED WORK

- A. 04500 - MASONRY RESTORATION
- B. Section 01530 - Barriers and Enclosures - for temporary barricades when railings are removed.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Bolts, Nuts and Washers: All new bolts, washers, set screw pins, rods and nuts shall be stainless steel ASTM 304.
- B. Handrail: # 4441 - 20' long Steel Handrail Moulding from Julius Blum & Co. Inc. or equal
- C. Electrodes for Welding: Comply with AWS Code.
- D. Anchor Bolts: Hilti stainless steel renovation anchors.
- E. Sealant: Two-part polyurethane sealant, Sika 2a or approved equivalent.
- F. Epoxy for setting railing posts. Sikadur - Lo-Mod epoxy resin or equal.

- G. Paint: The product given in parenthesis () is by Sherwin Williams Industrial Maintenance Coatings. Equal products by Tnemec or International Coatings may be submitted.

Preparation: Sandblast after restoration or fabrication to SSPC 10 Near-White Blast Cleaning.

1st Coat: Zinc Rich Primer: 3 mils DFT
(S.W. - Zinc Clad Primer)

2nd Coat: Epoxy Mid-Coat: 4 mils DFT
(S.W. - Recoatable Epoxy Primer)

3rd Coat: Hi-Solids Polyurethane: 4 mils DFT
(S.W. - Hi-Solids Polyurethane)

4th Coat: Hi-Solids Polyurethane: 4 mils DFT
(S.W. - Hi-Solids Polyurethane)

PART 3 - EXECUTION

3.01 FABRICATION

- A. Cut existing historic ironwork to remain in a manner that prevents any warping or distortion of the historic material and allows for smooth, even, butt joining of new to historic materials. Cuts in existing upper channel shall be made to allow for hairline joining. Obtain approval of method(s) from engineer.

3.02 ERECTION AND INSTALLATION

- A. Installation: Use nylon slings or padded cables for handling all metal fabrications, especially factory-primed or factory-finished materials.
- B. Install miscellaneous metal items and fabrications in their proper locations, anchored, rigid and secure, plumb and level unless otherwise shown, and in true alignment with related and adjoining work.

3.03 BOLT REPLACEMENT

- A. Bolts shall be removed in a manner approved by the engineer that will not damage the underlying connected material. The contractor shall be responsible for any damages inflicted as a result of his operations and shall rectify said damages to the satisfaction of the Engineer. Upon removal of each fastener the base metal around the hole shall be examined for surface irregularities and deterioration. All oxidized material shall be removed by reaming and grinding.
- B. Contact surfaces of all layers of steel through which fasteners will pass, except those which will not be exposed in the sequence of the work shall be prepared by removing all paint, oil and all other foreign substances as well as rust and loose scale.
- C. Holes may be reamed or drilled oversize as required to provide clearance for inserting or tightening new fasteners only with the permission of the Engineer. Otherwise diameter of holes shall be 1/16" larger than nominal diameter of fastener.

END OF SECTION

Appendix D: Historic Plant Lists

HISTORIC PLANS LIST

The following list of historic plans is a partial selected list of the material available for study and analysis. Our research into the available plans to date has been much more extensive than the following rather short list of plans. The plans listed are those that we have judged to be most significant, and we have, therefore, secured copies for reference purposes.

The total number of plans available at such sources as the Frederick Law Olmsted National Historic Site (FLONHS), Boston Parks and Recreation Department (BPRD), and Metropolitan District Commission (MDC) is extensive. For example, the total number of plans available for study at the Frederick Law Olmsted Historic Site (FLONHS), for the five jobs (916-Back Bay Fens; 923-Leverett Pond; 927 - Muddy River Improvement; 930 - Riverway; and 964-Olmsted Park) is over one thousand.

CHARLESGATE

- | | |
|---------------|---|
| Feb, 18, 1882 | Grading study of banks, Beacon Entrance, Back Bay Fens, by John C. Olmsted, pencil on tracing, FLONHS. |
| March 3, 1882 | Grading Plan for Beacon Entrance by John C. Olmsted, pencil on tracing, FLONHS. |
| March 1884 | Diagram that accompanied the planting contract for Beacon Entrance, Back Bay Fens, by John C. Olmsted, pencil on tracing, FLONHS. |
| c. 1885 | Tree planting plan for the northern basin, Back Bay Fens, by W.L. Fischer, pencil on tracing, FLONHS. |
| 1897 | Charlesgate, Ipswich Street Pier of Bridge on Charlesgate West and Grading, scale as indicated, Boston Street Department. |
| 1899 | Charlesgate, Sea Wall, Gate Chamber & Filling, The Fens, BPRD#12207A, scale as indicated. |
| 1912 | Charlesgate, Commonwealth Avenue Treatment of Subway Incline, Details of Entrance and Portal, Arthur Shurtleff, BPRD, scale 1/4"=1'. |
| 1912 | Charlesgate, Lower basin record construction plan, Berkley Street to Charlesgate West, Charles River Reservation, MDC#9285, scale 1"=50'. |
| 1921 | Charlesgate, Back Bay Fens Compiled Plan, Arthur A. Shurtleff, BPRD, scale 1"=40'. |
| 1923 | Charlesgate, plan for the vicinity of The Charlesgate, Arthur Shurtleff, BPRD, scale 1"=40'. |
| 1923 | Charlesgate, Plan for the vicinity of the Charlesgate and Commonwealth Ave., Arthur Shurtleff, BPRD, scale 1"=40'. |
| 1925 | Charlesgate, Reconstructing Fens Roads, BPRD#12229A, scale 1"=40'. |

1926	Charlesgate, Study for the vicinity of Gaston Square, Back Bay Fens, Arthur Shurtleff, BPRD, scale 1"=40'.
1928	Charlesgate, proposed changes at Charlesgate, Arthur Shurtleff, BPRD, CBA FE0021PM, scale 1"=80'.
1930	Commonwealth Avenue, Proposed underpass on Commonwealth Avenue, Arthur Shurtleff, BPRD CBA CA0002PM scale 1"=40'.
1931	Charlesgate, Charles River Basin, Preliminary Plan, Arthur Shurtleff, City Archives MS0006PM, scale 1"=200'.
1931	Charlesgate, Plan for the Vicinity of Gaston Square, Back Bay Fens, Arthur Shurtleff, BPRD, CBA CA0003PM, scale 1"=40'.
1932	Charlesgate, Charles River Basin, Widening and Extension of Boston Embankment near Mt. Vernon street to Longfellow Bridge, Construction plans, MDC#21007, scale 1"=50'.
1932	Commonwealth Avenue, Governor's Square, Plan for Central area, Arthur Shurtleff, FE0021PM scale 1"=40'.
1934	Charles River Basin, Planting Plan for Shrubs, MDC, Arthur Shurtleff, BPRD#21905, scale 1"=50'.
1935	Commonwealth Ave. Governor's Square, Proposed Planting Plan, Arthur Shurtleff, BPRD CBA FE0021PM, scale 1"=40'.
1949	Charlesgate, Charles River Basin, Cottage Farm Bridge to Charlesgate West, MDC, #21383, scale 1"=50'.
1951	Charlesgate, Charlesgate interchange, Storrow Memorial Drive, Construction plans, MDC#30508X, scale 1"=40'.
1956	Charlesgate, Storrow Drive, Storage-controlled Traffic Signal System, layout plan and controller data, MDC#34671X, scale 1"=20'.
1956	Charlesgate, Commonwealth Avenue reconstruction traffic signal system, Charlesgate East and West, MDC#35430X, scale 1"=50'.
1957	Charlesgate, Charles River Reservation, Record Plans, Storrow Drive, Boston University Bridge to Fiedler Bridge, Embankment Road, Fiedler Bridge to Nashua Street, BPRD, scale 1"=50'.
No date c. 1930's	Charlesgate, Back Bay Fens, proposed Waterways between the Fens and the Charles River basin, (2 sheets), Arthur Shurtleff, BPRD, scale 1"=40'.
No date c. 1930's	Charlesgate, Plan for the vicinity of Charlesgate and Commonwealth Avenue, Arthur Shurtleff, BPRD, scale 1"=40'.
No date c. 1930's	Charlesgate, Compiled survey of vicinity of Gaston Square, Back Bay Fens, Arthur Shurtleff, BPRD, scale 1"=40'.

BACK BAY FENS

- Dec. 4, 1878 Back Bay Park Plan Showing Contour of Hard Bottom (survey), FLONHS #916-1A, scale 1"=100'.
- 1879 Proposed Improvement of Back Bay, Olmsted's first published plan, Lithograph, FLONHS, scale 1"=100'.
- 1885 Improvement of Back Bay Showing Progress of Portions of Work to Dec. 31, 1885, FLONHS, scale 1"=100'.
- 1887 Map of the Back Bay Fens Showing the Public Ways Commonwealth Avenue, Beacon Street and Audubon Road, FLONHS, scale 1"=200'.
- 1894 Park System from Common to Franklin Park including Charles River, Muddy River Improvement, Leverett Park, Jamaica Park, Arborway and Arnold Arboretum, FLONHS, Scale 1"=400'.
- 1895 The Fens Sketch for Location of Boat House at Huntington Entrance, FLONHS, scale 1"=40'.
- 1895 The Fens Sketch for Location of Landing and Storehouse and Storehouse for Boats near Huntington Entrance, FLONHS, scale 1"=40'.
- Jul. 30, 1902 Plan of Lands in Back Bay belonging to Boston Water Power Co., revised October 1907, scale 1"=400'.
- Feb. 1912 Back Bay Fens Plan for the Extension of Jersey Street, Arthur A. Shurtleff, BPRD, scale 1"=40'.
- Aug. 1912 Back Bay Fens Sketch Plan Showing Location for Small Stadium and Small Base Ball Stand, BPRD, Arthur A. Shurtleff, no scale.
- 1912 Back Bay Fens Playgrounds in Vicinity of the Proposed Jersey Street Extension, BPRD, Arthur A. Shurtleff, scale 1"=40'.
- Nov. 1919 Back Bay Fens Plan for the Extension of Jersey Street, Arthur A. Shurtleff, BPRD, scale 1"=40'.
- 1921 Diagram of Tentative Contours to Accompany Revised General Plan for Back Bay Fens, Arthur A. Shurtleff, scale 1"=100'.
- 1921 Filling Studies for 1921 Compiled Surveys. BPRD#12210A-12215A.
- 1921 Compiled Survey Back Bay Fens, scale 1"=150' (master key plan) for sheets 2 through 8, Arthur A. Shurtleff, BPRD#12002J scale 1"=40'.
- 1921 Compiled Survey (sheets 2 through 8) BPRD#12227A-12221A(respectively), scale 1"=40'.
- Feb. 1922 Back Bay Fens, Plan for the Vicinity of the Museum of Fine Arts, Arthur A. Shurtleff, CBA-FE0017AM scale 1"=40'.
- 1923 Back Bay Fens, Plan for Athletic Field, Arthur A. Shurtleff, BPRD#12007A scale 1"=40'.

1923	Back Bay Fens, Contour Plan for Grading, vicinity of Meadows South of Richardson Bridge, Arthur A. Shurtleff, scale 1"=40'.
April, 1927	Back Bay Fens Plan for Vicinity of the Museum of Fine Arts, BPRD, Arthur A. Shurtleff, scale 1"=40'.
1927	Back Bay Fens, Grading and Loaming at Fens Athletic Field Back Bay, BPRD#12228A, scale 1"=40'.
1927	Excavating, Filling, Loaming and Dredging in the Fens between Boylston Street, Audubon Road, Fenway and Agassiz Road., BPRD#12231A, scale 1"=40'.
1927	Fens Playground, Arthur A. Shurtleff, BPRD, scale 1"=40'.
1927	Back Bay Fens, Grading and Loaming in the Fens Between Audubon Road and Fens Pond, BPRD#12235A, scale 1"=40'.
1927	Back Bay Fens, The Lagoon Opposite Art Museum, BPRD#12234A, scale 1"=40'.
1927	Back Bay Fens, Fens improvement opposite Art Museum, BPRD#12232A, scale 1"=40'.
1928	Compiled Survey, City of Boston, from Brookline Avenue at Sears to Perkins and the Jamaicaaway only to Burroughs St., Arthur A. Shurtleff, scale 1"=80'.
1929	Back Bay Fens, Filling and Loaming in Fens Athletic Field, Back Bay, BPRD#12239A, Arthur A. Shurtleff, scale 1"=40'.
1927	Fens Pond-Back Bay, rustic wooden bridges, BPRD#12233A, scale ½"=1'.
1929	Back Bay Fens, Building Granite Composite Bleachers in the Fens Athletic Field, Back Bay, BPRD#12237A.
1930	Back Bay Fens, no title, Grading and dredging study for the lagoon and lawn area with sections to show grading, BPRD, scale 1"=40'.
April 29, 1931	Back Bay Fens Vicinity of Art Museum, BPRD, Arthur A. Shurtleff, scale 1"=40'.
1931	Fens Playground, BPRD, Arthur A. Shurtleff, scale 1"=40'.
1931	Back Bay Fens, enlargement of Rose Garden, Arthur A. Shurtleff, scale ¾"=1'.
1931	Back Bay Fens, Rose Garden, details for water basin, BPRD, Arthur A. Shurtleff, scale ½"=1'.
1931	Back Bay Fens, sections, BPRD, no scale.
1931	Back Bay Fens, no title, Plan showing the Layout of the Rose Garden, BPRD, Arthur A. Shurtleff, no scale.
1933	Back Bay Fens, No Title, Plan for Athletic Field and Lagoon Behind Museum of Fine Arts; Arthur A. Shurtleff, no scale.
Feb.18, 1933	Back Bay Fens Sketch for Lagoon near Art Museum, BPRD, Arthur A. Shurtleff, scale 1"=40'.

1934	Back Bay Fens, Rose Garden, Plan, showing location of interior beds and arches, Arthur A. Shurtleff, scale 1"=20'.
1948	Park Drive, Aggasiz Road, BPRD, scale 1"=30'.
1959	Back Bay Fens, The Fens—North Meadows, Preliminary Plan of Proposed Parking Area, BPRD#12208B, scale 1"=40'.
1989	Proposal for Sears Parking Lot, Olmsted Plaza Association, scale 1/32"=1'.
No date c. 1930's	Back Bay Fens, Jersey Street Extension, Arthur A. Shurtleff, scale 1"=150'.
No date c. 1930's	Back Bay Fens, Sketch for Jersey Street Extension, BPRD, scale 1"=300'.

RIVERWAY

July 23, 1881	Plan of Proposed Muddy River Improvement showing contours, left and right halves, Riverway and Olmsted Park, (survey prior to Olmsted's work), FLONHS #930-1, scale 1"=100' (2 photos).
1890	Riverway (Boston Side) Grading Plan Downer Street Section D, BPRD#14202B, scale 1"=40'.
1890	Riverway (Boston Side) Grading Plan, Section A, BPRD#14005A, scale 1"=40'.
1890	Riverway (Boston Side) Grading Plan, Section B, BPRD#14003A, scale 1"=40'.
1890	Riverway (Boston Side) Grading Plan, Section C, BPRD#14002A, scale 1"=40'.
Dec. 1891	Muddy River Improvement, Planting Plan along B & A R.R. from St. Mary's to Longwood Ave, right and left halves, FLONHS #927-90, Scale 1"=20' (2 photos).
Dec. 1891	Muddy River Improvement, Planting Plan, Downer Street Section, right and left halves, FLONHS #927-93, Scale 1"=20' (2 photos).
Dec. 1891	Muddy River Improvement, Planting Plan along B & A R.R., right side, FLONHS #927-91, scale 1"=20' (photo).
Mar. 12, 1892	Muddy River Improvement, right and left halves, Along B & A R.R.-planting study with views, FLONHS #927-96, scale 1"=20' (2 photos)
Dec. 1892	Plan of the Parkway between Muddy River Gate House and Jamaica Park, FLONHS# 923-95B, scale 1"=100' (also photo)
Mar. 7, 1892	Planting study with massings and views from Riverway, Saint Mary's to Longwood Avenue, FLONHS #927-95, scale 1"=20'.
Mar. 12, 1892	Planting study with massings and views from Riverway, along B & A RR FLONHS #927-96, scale 1"=20'.
Mar. 1892	Muddy River Improvement, Island Section Planting Plan, Brookline Avenue to B & A R.R., (date on plan is Dec 1891), FLONHS #927-92, scale 1"=20' (photo).

- Mar. 12, 1892 Planting study with massings and views from Riverway, Island Section FLONHS #927-97, scale 1"=20'.
- Mar. 12, 1892 Muddy River Improvement, right and left halves, Island Section, planting study with views, FLONHS #927-97, scale 1"=20' (2 photos).
- Mar. 13, 1892 Planting study with massings and views from Riverway, Downer Street Section FLONHS #927-98, scale 1"=20'.
- Mar. 13, 1892 Muddy River Improvement, right and left halves, Downer Street Section, planting study with views, FLONHS #927-98, scale 1"=20' (2 photos).
- Apr. 11, 1892, Planting study with massings and views from Riverway, Longwood Avenue to Francis Street, FLONHS #927-102, scale 1"=20'.
- Apr. 12, 1892 Planting study with massings and views from Riverway, Island Section FLONHS #927-106, scale 1"=20'.
- Apr. 12, 1892 Planting study with massings and views from Riverway, Downer Street Section FLONHS #927-107, scale 1"=20'.
- Apr. 14, 1892 left and right halves of Planting Plan for Muddy River Improvement, Section from Longwood Avenue to Francis Street, FLONHS #927-103, scale 1"=10' (2 photos).
- Mar 1892 (Drawing also states Dec 1891) Grading Plan, Brookline Side, Muddy River Improvement Island Section from Brookline Avenue to the B & A R.R., FLONHS#927-92, scale 1"=20'.
- 1893 The Parkway, Topographic Plan for Planting Study Section 1 Brookline Ave. to St Mary's, FLONHS#930-60, scale 1"=10'.
- 1893 The Parkway, Topographic Plan for Planting Study Section 2 St. Mary's to Longwood, FLONHS#930-61, scale 1"=10'.
- 1893 The Parkway, Topographic Plan for Planting Study Section 3 Longwood to Brookline Ave. St. Mary's, FLONHS#930-62, scale 1"=10'.
- 1893 The Parkway, Topographic Plan for Planting Study Section 5 Brookline Ave. to Tremont St., FLONHS#930-63 scale 1"=10'.
- Jan. 9, 1893 Riverway, Audubon Road to Saint Mary's, Enlargement for planting, FLONHS#930-55, scale 1"=20'(photo)
- 1894 Riverway and Leverett Park, Plan showing position of electric lights and conduits (sheet # 1), BPRD#14203A, scale 1"=40'.
- 1894 Riverway and Leverett Park, Plan showing position of electric lights and conduits (sheet # 3), BPRD#14202A scale 1"=40'.
- 1894 Riverway and Leverett Park, Plan showing position of electric lights and conduits (sheet # 5), BPRD#18214A, scale 1"=40'.
- 1894 Riverway and Leverett Park, Plan showing position of electric lights and conduits (sheet # 6), BPRD#14200A, scale 1"=40'.
- 1894 Riverway and Leverett Park, Plan showing position of electric lights and conduits (sheet # 7), BPRD#14203A, scale 1"=40'.

- 1921 Riverway, Record Plan, (Sheet 2), BPRD#14206A, scale 1"=40'.
- 1922 Riverway, Record Plan, (Sheet 3), BPRD#14207A, scale 1"=40'
- 1942 Riverway, Fenway to Huntington Ave., BPRD#14215, scale 1"=200'.
- 1951 Construction of By-pass Roadway between Park Drive and Riverway, BPRD #14217A, scale as noted.
- 1960 Arborway-Jamaicaway-Riverway Construction plans (12 sheets) Center St. to Longwood Avenue, MDC, scale 1"=40'.

OLMSTED PARK

- July 23, 1881 Plan of Proposed Muddy River Improvement showing contours, left and right halves, Riverway and Olmsted Park, (survey prior to Olmsted's work), FLONHS #930-1, scale 1"=100' (2 photos).
- 1881 General Plan for the Sanitary Improvement of Muddy River and for Completing a Continuous Promenade Between Boston Common and Jamaica Pond, Lithograph, FLONHS, scale 1"=100'.
- c.1890 Olmsted Park, Grading Plan, Section D, BPRD, #18204A, scale 1"=40'.
- c.1890 Olmsted Park, Grading Plan, Section E, BPRD, #18205A, scale 1"=40'.
- c.1890 Ward's Pond, Grading Plan, BPRD, #18207A, scale 1"=40'.
- Dec. 1891 Muddy River Improvement, Planting Plan, Brookline Road from Washington Street to Cumberland Avenue, right and left halves, FLONHS #927-94, Scale 1"=20' (2 photos)
- 1892 Olmsted's revised plan for the Muddy River Improvement titled Plan of the Parkway Between Muddy River Gate House and Jamaica Park, as published in 1892, Lithograph, FLONHS, scale 1"=100'.
- Oct. 18, 1892 Leverett Park, Grading Study, Willow Pond Road and Perkins Street, FLONHS #923-52, scale 1"=40'.
- 1892 Outline of revised Plan for the Parkway and Sanitary Improvement of the Muddy River, dated 1889, FLONHS #930-81, scale 1"=300', with notes by John Charles Olmsted and Warren Manning, dated 1892.
- Mar. 15, 1893 Muddy River Improvement, Planting Plan from Cumberland Avenue to Chestnut Street FLONHS #927-137 & FLONHS #927-136, scale 1"=20'.
- *Mar. 15, 1893 Muddy River Improvement, Planting Plan from Cumberland Ave. to Chestnut Street (includes plant list), FLONHS #927-136, scale 1"=20'.
- Apr. 20, 1893 Leverett Park, The Parkway, Grading plan for Walks and Ponds between Willow Pond Road and Perkins Street, FLONHS #923-99, scale 1"=40'.
- Feb. 8, 1893 Topographic Plan for Planting Study, Planting Plan Washington Street to Cumberland Avenue, FLONHS #927-133, scale 1"=10'.

Feb. 9, 1893	Topographic Plan for Planting Study, Section 6-from Cumberland Road to Highland Road, FLONHS #923-94, scale 1"=10'
1896	Leverett Park, Drain between Bynner Street and Leverett Pond, BPRD #18218A, scale 1"=40'
1898	Leverett Pond Grading Plan (also labeled as Olmsted Park engineering drawing 1903), John Furlong, Brookline Park Department, scale 1"=50'
1930	Planting on Riverway and Olmsted Park, BPRD #14208A, scale 1"=40'
1929	Olmsted Park, (Sheet 1 of 5) Works Progress Administration (WPA) Project #15401 BPRD #18203A, scale 1"=40".
1930	Olmsted Park, (Sheet 2 of 5) WPA Project #15401, BPRD #18202A, scale 1"=40".
1933	Jamaicaway, Jamaica Pond Outlet and Overflow to Ward's Pond, BPRD, scale as indicated.
Dec. 1936	Leverett Pond, Planting Plan, (2 sheets), BPRD # 2473, scale 1"=20'
1984	Shore Line Rehabilitation of Leverett Pond, Town of Brookline DPW, scale 1"=40'.
No date	The Parkway, Grading Plan for walks and ponds between Willow Pond and Perkins Street, BPRD #18000A, scale 1"=40'.

FLONHS	Frederick Law Olmsted National Historic Site
BPRD	Boston Parks & Recreation Department
MDC	Metropolitan District Commission
BPL	Boston Public Library
Brookline PL	Brookline Public Library
SPNEA	Society for the Preservation of New England Antiquities

HISTORIC PLANT LISTS

The following list of Historic Plant Lists is the published lists. We are currently preparing a list that will cite the original lists at the Frederick Law Olmsted National Historic Site (FLONHS). It should be noted that what Cynthia Zaitzevsky has published in Frederick Law Olmsted and the Boston Park System, Cambridge, MA., Harvard University Press, 1982 are exact versions of given original lists from FLONHS. Additional lists that has not been published, but are available at FLONHS have been included.

Back Bay Fens

Fischer, William L. "Key to Tree Planting Plan for the Northern Basin of the Back Bay Fens, ca. 1885, FLONHS (reproduced in Cynthia Zaitzevsky, Frederick Law Olmsted and the Boston Park System, Cambridge, MA., Harvard University Press, 1982, 190.

Olmsted, Frederick, Law. Plants for Beacon Entrance, 1884. Reconstructed from Olmsted's letters to F. L. Temple, the contract between the Boston Park Commission and Temple, and Charles Eliot's diaries. Published in Cynthia Zaitzevsky, Frederick Law Olmsted and the Boston Park System, Cambridge, MA., Harvard University Press, 1982, 188.

Olmsted, Olmsted and Eliot, Warren H. Manning, Superintendent of Planting. Order for Plants for the John Boyle O'Reilly Monument, August 9, 1897. FLONHS.

Riverway

Muddy River Improvement Plant Lists for Brookline and Boston, 1892 and 1893. Published in Cynthia Zaitzevsky, Frederick Law Olmsted and the Boston Park System, Cambridge, MA.: Harvard University Press, 1982, 216-218.

Plants deleted by Sargent from April 1892 plant list for Brookline side: Saint Mary's Street to Cumberland Avenue. Published in Cynthia Zaitzevsky, Frederick Law Olmsted and the Boston Park System, Cambridge, MA.: Harvard University Press, 1982, 219.

Additional plants ordered by Olmsted firm for Brookline, 1893. Published in Cynthia Zaitzevsky, Frederick Law Olmsted and the Boston Park System, Cambridge, MA.: Harvard University Press, 1982, 220.

Olmsted Firm list prepared for William Fisher for the Boston side of the Muddy River and Olmsted Park, 1893, FLONHS.

**Appendix E: MEMORANDA OF AGREEMENT BETWEEN
CITY OF BOSTON AND TOWN OF BROOKLINE**

**1999 MEMORANDUM OF AGREEMENT BETWEEN CITY
OF BOSTON AND TOWN OF BROOKLINE**

**MEMORANUM OF AGREEMENT
BETWEEN
CITY OF BOSTON AND TOWN OF BROOKLINE**

AGREEMENT made this 8th day of June by and between the Town of Brookline, a municipal corporation located in Norfolk county, Massachusetts acting through its Department of Public Works (hereinafter, "Brookline") and the City of Boston, a municipal corporation located in Suffolk County, Massachusetts acting through its Parks and Recreation Department (hereafter, "Boston").

WHEREAS, the Muddy River in the Emerald Necklace is a joint responsibility of Boston and Brookline due to the municipal boundaries running through the center of the Muddy River, Leverett Pond, the Bubbling Brook, Willow Pond, and the stream from Wards Pond (See Exhibit "A"); and,

WHEREAS, Boston and Brookline seek to remedy the flooding, water quality, and habitat of the Muddy River system through the engineering and construction of restoration work; and,

WHEREAS, the Federal Emergency Management Agency (hereinafter, "FEMA"), the Federal Housing and Urban Development (hereinafter, "HUD") and the Massachusetts Emergency Management Agency (hereinafter, "MEMA") have granted funds for flood hazard mitigation of the Muddy River, and the Commonwealth of Massachusetts Department of Environmental Management (hereinafter "DEM"), the Boston Water and Sewer Commission (hereinafter, "BWSC") and the Brookline Public Works Department have allocated funds for the Muddy River; and,

WHEREAS, Boston and Brookline seek to investigate and secure additional monies for the Muddy River Restoration; and,

WHEREAS, it has been determined that a jointly undertaken design and contract process will inure to the mutual benefit of the citizens of Boston and Brookline; and,

NOW, THEREFORE, in consideration of the mutual covenants herein contained, the sufficiency of which is hereby acknowledged, the parties hereto do mutually agree as follows:

ARTICLE I. PARTIES RESPONSIBILITIES

A. Boston shall:

1. in accordance with applicable provisions of Massachusetts General Laws, contract for design and construction services to accomplish the goals of the restoration of the Muddy River; and,
2. through contract services, provide all labor, equipment, materials, and other services necessary for the Phase I Muddy River work as described in "The Emerald Necklace Environmental Improvements Master Plan; Phase I Muddy River Flood Control, Water Quality and Habitat Enhancement; Environmental Notification Form, January 1999;" and,
3. prior to publication or execution, provide Brookline with all documents related to the above described work; and,
4. notify Brookline in writing of any change in the Scope of Work as defined through the contract documents, including therein an explanation of the same so that any necessary amendment or revision to the contract agreement may be made to cover the work; and

5. furnish to Brookline a written report on the progress of the project as such reports are produced in accordance with the provisions of the contract documents.

Brookline shall:

1. upon request, be permitted to inspect and copy all records related to the work;
and,
2. at all reasonable times; have access to the work site to inspect the work; and,
3. provide existing specifications or drawings for any projects or programs that impact the Muddy River and its watershed; and,
4. review all documents provided by Boston in timely manner;
5. provide a detailed maintenance plan to Boston, delineating the care and responsibilities for the upkeep of all improvements pursuant to the provisions of this agreement; and
6. Cooperate and assist Boston with scheduling and communicating to Brookline regulatory agencies and coordinating public meetings and hearings.

ARTICLE II. INCORPORATION

This Agreement is subject to the terms and conditions of the Massachusetts Standard Contract, and attachments appurtenant thereto, by and between the City of Boston and the Commonwealth of Massachusetts Department of Environmental Management relative to the Muddy River.

ARTICLE III. MUTUAL COOPERATION

Boston and Brookline shall designate representatives to meet regularly with the Citizens Advisory Committee, Massachusetts Environmental Protection Agency, and other agencies as necessary for the purposes of design review and project status reports.

ARTICLE IV. INDEMNIFICATION/LIABILITY

Any contractor working on the project shall indemnify Boston and Brookline, and their officers, agents, servants and employees against any and all claims, suits or liability of any nature whatsoever arising out of or resulting from the project in the amount of forty-five million dollars (\$45,000,000).

ARTICLE V. TIME/METHOD OF PAYMENT

1. Boston shall act as the fiscal agent for Brookline. Boston shall finance the planning, design, engineering, permitting, and construction associated with the Muddy River restoration, and be reimbursed by FEMA, HUD, MEMA, DEM and other agencies for expenditures made pursuant to the terms of their respective agreements.
2. In the event of additional work, involving costs not provided for by any other grant program or existing appropriated municipal funds, Brookline shall consider, subject to appropriation and subject to prior approval by Brookline, paying Boston for all or a portion of the additional work upon its completion. Should Brookline not approve Funds for additional work, then Boston has no obligation to conduct additional work involving costs not otherwise provided for and has complete discretion as to what additional work, if any it will undertake.
3. Proposals from Boston for additional work, shall be approved in advance by Brookline except in the case of a condition which is an actual threat to the public safety in which case Boston shall endeavor to notify Brookline of the need for the work as soon as practicable.

ARTICLE VI. RECORD KEEPING AND REPORTS

Boston shall keep accurate and comprehensive records of the services performed, the costs incurred and the reimbursements and contributions received. Every six months and upon termination of this agreement, Boston shall make available all records for Brookline to prepare a financial statement detailing, among other things, the services performed, the costs, incurred and reimbursements and contributions received for the work in the previous six months.

ARTICLE VII. SEVERABILITY

If any provision of this Agreement is declared or found to be illegal, unenforceable, or void by a court of competent jurisdiction, then both parties shall be relieved of all obligations under that provision. The balance of the Agreement shall be enforced to the full extent permitted by Massachusetts law unless one or both parties would be materially prejudiced.

ARTICLE VIII. ARTICLE HEADINGS

The headings of the Articles set forth herein are for convenience or reference only and are not a part of this Agreement and shall be disregarded in construing or interpreting any of the provisions of this Agreement.

ARTICLE IX. GOVERNING LAW

This agreement shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts.

ARTICLE X. TERM

This Agreement shall take effect as of the day and year first written above and shall terminate on June 30, 2005, or upon completion of the Muddy River restoration,

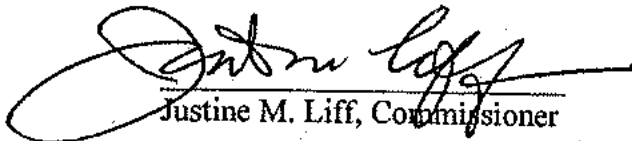
whichever is sooner; provided that, in the event that funding is not available, or for any reason whatsoever, cannot be made available for this project, this Agreement shall terminate.

In the event that Boston is notified by the FEMA, HUD, MEMA, DEM, or other funding agency that the project is terminated, Boston shall immediately notify Brookline in writing and, thereafter, neither Boston nor Brookline shall have any obligations under this Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their respective duly authorized representative.

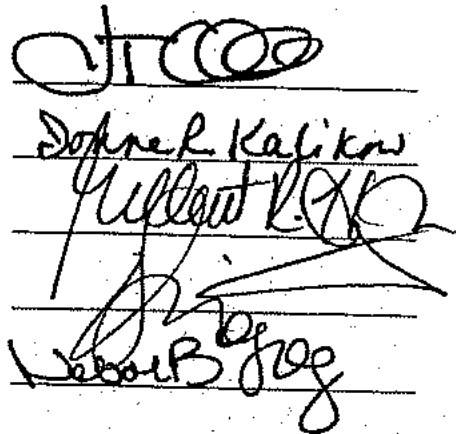
CITY OF BOSTON

By: The Parks and Recreation
Department

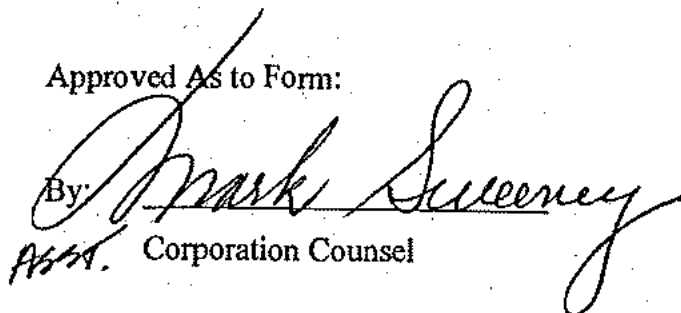

Justine M. Liff, Commissioner

TOWN OF BROOKLINE

By: Board of Selectmen


Daniel Kalikow
William R. [unclear]
[unclear]
Robert B. [unclear]

Approved As to Form:

By: 
Mark Sweeney
Asst. Corporation Counsel

Approved As to Form:

By: 
[unclear]
Town Counsel

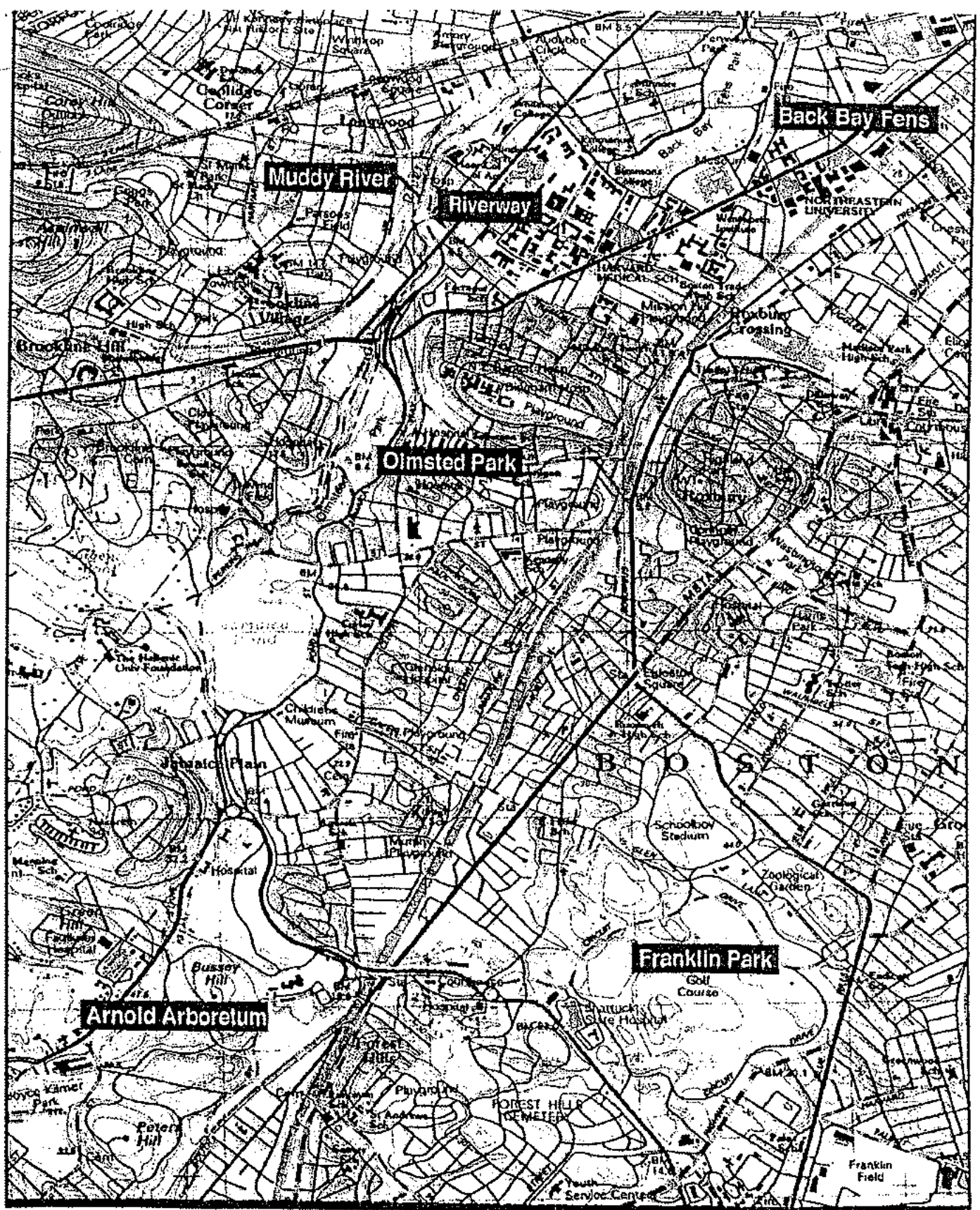


EXHIBIT "A"

PROJECT LOCATION

SOURCE: U.S.G.S. (1987)



Boston Parks
and Recreation
Department

***Emerald Necklace Environmental
Improvements Master Plan***
Environmental Notification Form
Boston, Massachusetts

Figure **CORTELL
ASSOCIATES**

0' 2083'

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DRAFT MEMORANDUM OF AGREEMENT BETWEEN CITY OF BOSTON AND TOWN OF BROOKLINE

- **Draft Memorandum of Agreement**
- **Memorandum from Emerald Necklace Conservancy**
- **MMOC Draft of Memorandum of Agreement**

**MEMORANDUM OF AGREEMENT
BY AND AMONG
THE EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS, THE DEPARTMENT OF CONSERVATION
AND RECREATION¹, THE CITY OF BOSTON, THE TOWN OF BROOKLINE, THE EMERALD
NECKLACE CONSERVANCY, THE MAINTENANCE AND MANAGEMENT OVERSIGHT COMMITTEE,
CONCERNING ROLES AND RESPONSIBILITIES FOR
MAINTENANCE AND MANAGEMENT FOR THE
MUDDY RIVER RESTORATION PROJECT
IN THE CITY OF BOSTON AND THE TOWN OF BROOKLINE**

WHEREAS, Frederick Law Olmsted left the people of the nation and of the Commonwealth of Massachusetts a magnificent historic, cultural and environmental legacy of public parks and open spaces;

WHEREAS, in January of 1984 the Commonwealth of Massachusetts committed itself to reclaiming that legacy by creating the Olmsted Historic Landscape Preservation Program and the “Emerald Necklace Master Plan” of 1990, updated in 2001; and, the Commonwealth’s mission is to preserve significant historic landscapes and to encourage the public’s appreciation, understanding, wise use and maintenance of this historic legacy;

WHEREAS, the health, safety and quality of life of the residents and communities of Boston and Brookline have been threatened by and subject to flooding, impaired water quality and degraded habitat related to the Muddy River in the Boston Park System known as the Emerald Necklace;

WHEREAS, in accordance with a Memorandum of Agreement (“MOA”), dated June 8, 1999, the City of Boston and the Town of Brookline---accepted responsibility for the implementation of the Emerald Necklace Environmental Improvements Master Plan and the Phase I Muddy River Flood Control, Water Quality, Landscape Restoration and Habitat Enhancement Project (EOEA# 11865) (the master plan and the projects contained therein and Phase I for the area between the Charles River and Perkins Street by Jamaica Pond collectively referred to as the “Project”, and the first portion of Phase I referred to as “Charlesgate”);

WHEREAS, the Executive Office of Environmental Affairs (“EOEA”), the Department of Environmental Management, the Massachusetts Emergency Management Agency, the Boston Water and Sewer Commission, the Town of Brookline (“Town”) and the City of Boston (“City”) committed to a Memorandum of Understanding, dated November 4, 1999, concerning the funding and administering of the planning, permitting, and design of Phase I of the Project and the construction and implementation of Charlesgate, and in which the City and Town accepted responsibility for their respective shares of future maintenance and management activities, including the implementation of best management practices, as will be identified in a maintenance and management plan, to be submitted jointly by the City and the Town to the Secretary of Environmental Affairs, and to be reviewed as part of the review for adequacy of the environmental impact report pursuant to the Massachusetts Environmental Policy Act (“MEPA”), sections 61-62H of Chapter 30 of the General Laws and its associated regulations;

¹ The Department of Conservation and Recreation is the successor agency to both the Department of Environmental Management and the Metropolitan District Commission pursuant to Chapters 26 and 41 of the Acts of 2003.

WHEREAS, the Secretary of Environmental Affairs issued pursuant to MEPA a certificate, dated May 1, 2003 reaffirming that maintenance and management are key to ensuring that the Project meets its long-term goals and that the significant public investment in the project, is adequately protected; and the certificate further acknowledges the need and requirement to clearly define the structure, roles and responsibilities, and develop adequate enforceable commitments for long-term maintenance and management of the Project area to protect the substantial investment, both the incurred and anticipated, of federal, state, and local public funds to implement the Project, for which the state is assuming most of the City's and the Town's share of the non-federal portion of the capital costs of the Project in recognition of the commitment by the City and Town to the implementation of such long-term maintenance and management obligations;

WHEREAS, the Secretary of Environmental Affairs required the establishment, pursuant to the Final Record of Decision on the Phase One Waiver concerning Charlesgate, of an independent oversight committee known as the Muddy River Restoration Project Maintenance and Management Oversight Committee ("MMOC");

WHEREAS, the parties firmly believe that ongoing coordination between the Parties, the development of public-private partnerships, fostering public education and participation and the evaluation of the short- and long-term maintenance and management are critical components of ensuring appropriate stewardship of the Project area;

WHEREAS, the parties agree that proper maintenance and management are critical for achieving all of the project goals, as absent these elements, sediment will quickly reaccumulate in the river, degrading water quality and wildlife habitat and endangering the historic landscape with the direct threat of invasive species and the indirect threat of benign neglect;

WHEREAS, the parties to this memorandum (hereinafter the "parties") believe it is appropriate to recognize and outline their respective roles and responsibilities relative to maintenance and management of the Project area to ensure the preservation and protection of this unique Olmsted park system;

NOW, THEREFORE, in order to clearly define the roles and responsibilities for certain maintenance and management activities associated with the Project area, the parties agree as follows:

1. Purpose. The parties commit to this agreement concerning the Project to:
 - (a) protect the substantial public investment to restore, improve, and provide proper stewardship of the natural, recreation, and cultural resources in the Project area;
 - (b) comply with state, federal and local laws and permits, and the anticipated conditions of state and federal project agreements associated with the Project;
 - (c) make clear the roles and responsibilities for the implementation of the required maintenance and management plan in a transparent and comprehensive manner;

(d) establish a framework for ongoing, public participation and evaluation of the progress on the implementation of the maintenance and management plan and associated activities both in the short- and long-term;

(e) foster mechanisms to create and maintain public-private partnerships to support the stewardship and improvement of the natural, recreational and cultural resources;

(f) further consistent, coordinated inter-, intra-, and extra-governmental communications in furtherance of seamless and, from the perspective of the public, transparent implementation of the maintenance and management obligations of various public landowners proximate to the Project.

2. Maintenance and Management.

- (a) The City and the Town shall undertake maintenance and management obligations: as stated in the maintenance and management plan submitted by the City and Town, and reviewed and deemed adequate by the Secretary of Environmental Affairs (“Plan”); any conditions contained in relevant MEPA certificates of the Secretary; and any Section 61 findings issued pursuant to MEPA. Conformance with the Plan by the City and Town shall be considered independent legal obligations, specifically enforceable by the Commonwealth, and shall be incorporated as a condition of any contract for state financial assistance associated with the Project, as well as by any state agency to the extent conformance to the maintenance and management plan is a condition of a permit from that agency, regardless of availability of funds or appropriation by either the City or Town.
- (b) The parties agree that maintenance and management for parklands shall be conducted in accordance with the standards detailed in the plan. A portion of the plan, specifically pertaining to parklands, is attached as Appendix A to this agreement.
- (c) The parties agree that maintenance and management for parkways and roadways shall be conducted in accordance with the standards detailed in the plan. A portion of the plan, specifically pertaining to parkways and roadways, is attached as Appendix B to this agreement.
- (d) The parties agree that maintenance and management for stormwater shall be conducted in accordance with the standards detailed in the plan. A portion of the plan, specifically pertaining to stormwater, is attached as Appendix C to this agreement.
- (e) In a manner consistent with the practices used by City and the Town under the Plan, the DCR will use best management practices for the maintenance and management of the parkways and associated infrastructure under its care, custody and control.

3. Cabinet Management Structure

- (a) The long-term success of the Project is dependant upon maintenance and management in conformance with the maintenance and management plan for the stewardship of resources for which a substantial public investment will be committed. Essential measures in this stewardship include commitments to implementation and maintenance of storm-water best management practices, historic preservation and maintenance of project infrastructure and parklands and parkways. The parties recognize that long-term success of fulfilling project goals cannot be achieved without open lines of communication and sharing of information among the parties and the public, as well as coordination of activities across jurisdictional boundaries and appropriate staffing to implement the maintenance and management plan. To this end, the parties hereby establish a Management Cabinet (the “Cabinet”) to formalize a maintenance and management structure to oversee the Project in furtherance of these purposes and achieving and maintaining the long-term success of the Project.
 - (b) DCR, the City, the Town, the Emerald Necklace Conservancy (“ENC”) and the MMOC, or their respective designees, shall be voting members of the Cabinet, each possessing one vote. The Cabinet shall meet at least quarterly, with one of those meetings being an open and public meeting. A quorum necessary to conduct a meeting of the Cabinet shall consist of a simple majority of the voting members of the Cabinet. All decisions of the Cabinet shall be by made by simple majority of the quorum present at the meeting. The Cabinet shall hold meetings at least quarterly and otherwise as needed.
 - (c) The Cabinet shall have a Chair that shall preside over the Cabinet and its meetings. The Chair shall serve for a term of one year. The Chair shall be elected by a majority vote of the Cabinet.
 - (d) The Cabinet shall serve primarily as a mechanism and forum for high-level management officials to discuss and consider: the range of issues associated with maintenance and management, historic preservation, stewardship and performance standards, including the appropriate capital and operating funding; the implementation, review, potential modification, and enforcement of standards pertaining to these issues; achievements and ongoing cooperation in furtherance of implementing new knowledge and lessons learned in the Project area; any needs of and potential assistance that could be provided by the parties.
 - (e) The Cabinet shall be the forum to facilitate coordination of the implementation of the maintenance and management plan among the parties. While the cabinet shall be the forum to address conformance with the maintenance and management plan, including the standards specified therein, the parties confirm that the Cabinet shall not administer or otherwise control day-to-day management or operation of any park lands, including lands, facilities, parkways or water courses, under the care and control of either the City, the Town or DCR; it being expressly understood that such is reserved to the City, the Town and DCR, respectively.
4. Maintenance and Management Oversight Committee (MMOC)
- (a) The parties agree that proper maintenance and management of the Project area are critical for achieving project goals, and that implementation of a continuing, independent

oversight body for the Project is essential to meeting these goals continually for the long-term and protecting the significant public investment in the Project. The parties agree that the MMOC, referenced and described in the MEPA Certificate dated May 1, 2003, shall fulfill such a role in the project management structure associated with the Project. The parties agree to communicate and share information with the MMOC, so that the MMOC may fulfill its function. The MMOC shall communicate and share information directly with the parties, so that the parties may fulfill their functions, including maintenance and management obligations as applicable. The MMOC shall inform the Cabinet of outstanding issues that require consideration and resolution.

- (b) The MMOC shall consist of a member from the following agencies or organizations (or their designee from within that agency or organization) provided that the Secretary, in her discretion, may add to or remove members from the MMOC:

[insert list]

- (c) Without limiting the role of the MMOC, the MMOC shall provide the primary forum and conduit for public participation in the independent review, oversight and decision-making process of the parties associated with the maintenance and management of the resources within the Project area. The MMOC shall endeavor to hold monthly meetings and additional meetings as necessary.

- (d) In implementing its role as described in paragraph (b), the MMOC shall have the following responsibilities: review and evaluate the implementation and progress of construction activities and maintenance and management standards; evaluate progress and provide independent oversight of maintenance and management activities; provide independent review and comment concerning reports and filings related to the Project area; monitor and evaluate compliance with permit, contract and legal obligations associated with the Project, including Section 61 findings; promote coordination and communication concerning maintenance and management activities among the Parties and the public; encourage representation of a broad public constituency on the MMOC; serve as a conduit for public participation and access to information concerning maintenance and management of the Project area; and report frequently any issues to the Cabinet for its discussion and consideration.

- (e) The Town and the City shall provide funding for the duration of the construction of the Project plus five years to support certain activities of the MMOC. Funding shall include \$35,000 per year from the City, \$20,000 per year from the Town, \$20,000 per year from DCR. . Funding for the MMOC shall be administered and distributed both in a manner and through a qualified organization acceptable to the parties *[Insert additional fiscal procedures text]*.

5. Role of the Emerald Necklace Conservancy

- (a) The ENC shall use best efforts to work with the Parties to assess and identify annual funding necessary for the maintenance and management of the Project area, funding for the administration and activities, and to assist DCR, the City and the Town to secure the necessary annual funding for DCR's, the City's and the Town's maintenance and management and capital obligations.

- (b) The ENC will facilitate the development of partnerships among the Parties and non-profit organizations; act as a liaison with the cultural and educational institutions in the neighborhoods along the Muddy River; and develop and implement public education and other programs to promote an understanding and appreciation of the landscape, waterways, parkways and features of the Emerald Necklace.
- (c) The ENC shall assist the Cabinet in its administration through, at the request of the Cabinet: assisting in convening meetings; identifying locations of Cabinet meetings; and disseminating materials relating to Cabinet meetings and activities.

6. Dispute Resolution.

In the event of a dispute related to this Agreement, the parties shall use the following as a condition precedent to either party pursuing other available remedies:

- (a) A party who believes a dispute exists (the “disputing party”) shall put such dispute in writing to the other party (the “responding party”). Such writing shall clearly, though as briefly as practicable, state the substance and scope of the dispute, the disputing party’s position relative thereto, including legal and factual justifications therefore, the remedy sought, and any other pertinent matters.
- (b) The responding party shall respond in writing to the disputing party within ten (10) days of receiving such writing. Such writing shall clearly, though as briefly as practicable, state the responding party’s response to each of the items included in the disputing party’s writing, and any other pertinent matters.
- (c) A telephone conference shall be held within ten (10) days between representatives of the parties having decision-making authority regarding the dispute, to negotiate in good faith a resolution of the dispute.
- (d) If, within ten (10) business days after such telephone conference, the parties have not succeeded in negotiating a resolution of the dispute, the parties’ representatives shall submit the dispute to mediation by contacting the MA Office of Dispute Resolution (MODR), who will administer the mediation process. The fees of, and authorized expenses incurred by, the mediation shall be shared equally by the parties.
- (e) The parties hereby agree to mediate in good faith for a minimum period of ten (10) days from the actual commencement of the mediation. If the parties are not successful in resolving the dispute through mediation, then the parties may agree to submit the matter to binding arbitration, or either party may pursue other available remedies upon ten (10) days written notice to the other party specifying its intended course of action. Any decision associated with the resolution of a dispute shall be presented and ratified at a meeting of the Cabinet.
- (f) The parties may mutually agree to extend any of the time periods stated herein.

- (g) The parties agree that the mediation provided for here is a compromise negotiation for purposes of all international, federal and state rules of evidence. The entire procedure will be confidential to the extent permitted by law. All conduct, statements, promises, offers, views and opinions, whether oral or written, made in the course of the mediation by any of the parties, their agents, employees, representatives or other invitees to the mediation and by the neutral, who is the parties' joint agent for the purpose of these compromise negotiations, are confidential and shall, in addition and where appropriate, be deemed to be privileged. Such conduct, statements, promises, offers, views and opinions shall not be discoverable or admissible for any purposes, including impeachment, in any litigation or other proceeding involving the parties and shall not be disclosed to anyone not an agent, employee, expert, witness, or representative for any of the parties. However, evidence otherwise discoverable or admissible in a later proceeding is not excluded from discovery or admission as a result of its use in the mediation. If not entirely enforceable, the parties intend that the court enforce this provision to the extent enforceable by such court.
- (h) The parties agree that nothing contained herein shall affect or limit, in any way, any party, as applicable, from independently exercising or enforcing its authority under any applicable statute, regulation or other provision of law that it is charged with administering.
7. US Army Corps of Engineers Project Agreement Conditions. The parties recognize that certain obligations and conditions will be associated with the Project that must be fulfilled by certain parties independent of this memorandum as part of any project agreement for the Project with the United States Army Corp of Engineers and local, state and federal project permits. The parties agree, however, that fulfillment of those conditions and obligations (in force or as lawfully modified) by the relevant parties shall be considered binding maintenance and management obligations under this memorandum.
8. Nothing in this memorandum, except as expressly stated, shall be construed to diminish, enlarge or modify any right or liability of any of the parties, or create liability on the part of any public agency for the act or omission of another public agency or a private person. Nothing in this memorandum shall be construed to amend, repeal or otherwise alter the authority or jurisdiction of any public agency. Nothing in this memorandum, including any process established herein, shall be construed to amend, repeal or otherwise alter any mitigation commitment, obligation or requirement pursuant to MEPA.

9. Effective Date and Term. The effective date of this agreement shall be the date of execution by the last of the parties to sign. The agreement shall remain in effect from the effective date and shall not expire until thirty-years from the completion date of the capital investments of the Project, unless the term is extended or modified with the unanimous agreement of all of the parties. This duration of the agreement represents the currently estimated expected life of the capital investments implemented, if maintained as anticipated, as part of the Project.

**For the Executive Office of
Environmental Affairs:**

Secretary Ellen Roy Herzfelder

Date: _____

**For the Department of
Conservation and Recreation:**

Commissioner Katharine Abbott

Date: _____

**For the Boston Parks and
Recreation Department:**

Commissioner Antonia Pollack

Date: _____

**For the Brookline Public
Works Department:**

Commissioner Thomas DeMaio

Date: _____

For the MMOC:

For the ENC:

Memorandum – Via e-mail and mail

to: Jim Hunt, MEPA
from: Simone Auster, ENC
date: December 21, 2004
re: Muddy River Restoration Project Memorandum of Agreement (MOA)

This memorandum summarizes the Emerald Necklace's Conservancy's ("ENC") major comments and questions on the first draft of the Memorandum of Agreement ("MOA") that you circulated. While this memo focuses on the major issues that are of concern to the ENC, we would also be happy to provide you with our proposed language changes and other content suggestions either in connection with this current draft or the next revised draft. We look forward to finalizing this agreement with you and the other parties.

1. **ENC Roles and Responsibilities:** We have drafted a new Section 5 of the MOA to replace the section in your current draft, and have enclosed that re-drafted section with this memo. The new provisions expand upon what we believe should be the ENC's dynamic role in connection with the Project and the Necklace as a whole. Please let us know if you have any comments on this revised section.
2. **Cabinet Management Structure:** We propose a number of changes to Section 3 in order to shore up the Cabinet's structure and procedures:
 - Section 3(b) should specify which individuals will serve as the Cabinet representatives for each party. Paragraph (d) calls for "high-level" officials, yet the Section does not specify who the representatives will be. The parties should agree on their representatives in advance.
 - As drafted, Section 3(b) requires three of the five Cabinet members in attendance for a quorum, and then allows that quorum to act on behalf of the Cabinet with a vote of the majority in attendance. That provision means that the Cabinet could act even if only two of the five members agree. We believe that the decisions of the Cabinet should require a higher degree of agreement to give the Cabinet's actions more legitimacy and a greater likelihood of enforceability. Please consider requiring three out of the five Cabinet members to agree on any decision; if a

quorum consists of only three members, all three must vote to take a given action.

- Section 3(b) should include additional detail about the process for calling special meetings. We suggest that the Chair should have the power to call such meetings, and that other parties should be able to call a limited number of special meetings per year.
- The version of the MOA drafted by the ENC's counsel (and discussed by a working group of representatives of the ENC, MMOC and the proponents) addressed each of the issues noted above, as well as additional details regarding the Cabinet's management procedures. If you would like a copy of that section for your reference, we would be happy to provide it.

3. **MMOC's Roles and Responsibilities:** While the ENC recognizes the important role that the MMOC will play in the Project, we propose certain revisions to the description of that role. Section 4(a) should make clear that while the parties agree to reasonably share information related to the Project with the MMOC, each other party retains a right to safeguard information related to its public or private organizational mission as it sees fit (or in the case of the public parties, as far as the Public Records Law will allow). In addition, Section 4(c) should be revised to clarify that the MMOC's direct participation in the "decision-making process of the parties" is limited to its role on the Cabinet, although the other parties will, of course, welcome any MMOC input at any time.
4. **Term:** The ENC proposes that the MOA's term consist of an initial term, which would expire five years from Project completion, followed by five-year extension terms that run automatically unless the parties agree to terminate the MOA, up to a total term of thirty years.
5. **Dispute Resolution:** We suggest that before two parties bring a dispute to the MODR, they should submit the dispute to the Cabinet for discussion. That step might generate a resolution agreeable to both parties, and thereby avoid the time-consuming and costly mediation process. Also, we would eliminate the requirement that the Cabinet ratify the results of mediations or arbitrations; as drafted, the MOA does not explain what would happen in the event that the Cabinet refused to ratify such result.

6. **Maintenance of Parkways and Roadways:** Section 2(c) appears to require that all parties (which would include DCR) will maintain and manage roadways in accordance with the Maintenance and Management Plan. Section 2(e), however, seems only to require DCR to maintain and manage the parkways “in a manner consistent with the practices used by City and the Town under the Plan.” We believe that DCR should commit to follow the standards set forth in the Plan, in order to promote consistent maintenance and management practices throughout the Necklace.

cc: Antonia Pollak, Margaret Dyson – Boston Parks Department
Erin Chute – Brookline Parks and Open Space
Marjorie Bakken - Chair, Emerald Necklace Conservancy
Peter Kochansky, Esq. – Goulston & Storrs

5. Role of the Emerald Necklace Conservancy

The Emerald Necklace Conservancy's role in the Muddy River Restoration Project may include but not be limited to facilitation and provision of private sector and community input to, and support for, the Project and related Emerald Necklace activities. Such input and support may take the form of:

- Advocacy on behalf of the Project and related Emerald Necklace issues;
- Review of budgets and contracts related to Project activities, as required; including compliance with MOUs and other project agreements;
- Assessment of on-going parks maintenance in light of established maintenance standards;
- Assist the Cabinet in its administration, including but not limited to serving as meeting convener; developing meeting agendas and collecting materials related to Cabinet meetings and activities; helping to identify priority projects related to restoration and maintenance; monitoring maintenance and other standards; and implementing reviews of agreed-upon plans;
- Promotion and implementation of volunteer/stewardship initiatives;
- Planning and facilitation of Project outreach and related public dialogue, as required, including ensuring coordination with, and collaboration among, the numerous non-profit organizations, residential groups and institutions surrounding the Emerald Necklace.
- Advocacy to ensure adequate project funding, including the continuation of the Conservancy's role as convener of the Project "funding coalition;"
- Implementation of public education efforts, including: sponsorship of public meetings on Project issues and progress; presentations, a newsletter, web site and other communications, as required, in order to raise public awareness of the Project and related issues such as parks restoration and maintenance.
- Encourage individuals to donate financial resources toward improvement of the park system in order to supplement and extend the capabilities of the public sector without replacing the public sector's responsibility for baseline maintenance and related funding;

- Establish cooperative management, restoration and maintenance projects in the parks, and collaborative masterplanning, as required; and,
- Develop, through the established public-private partnership, consistent Emerald Necklace standards (i.e., lighting, benches, trash barrels and other infrastructure) to ensure a seamlessly managed and maintained, and readily identifiable, park system.

**MEMORANDUM OF AGREEMENT
BY AND AMONG
THE EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS, THE DEPARTMENT OF CONSERVATION
AND RECREATION¹, THE CITY OF BOSTON, THE TOWN OF BROOKLINE, THE EMERALD
NECKLACE CONSERVANCY, THE MUDDY RIVER RESTORATION PROJECT MAINTENANCE AND
MANAGEMENT OVERSIGHT COMMITTEE
CONCERNING ROLES AND RESPONSIBILITIES FOR
MAINTENANCE AND MANAGEMENT FOR THE
MUDDY RIVER RESTORATION PROJECT
IN THE CITY OF BOSTON AND THE TOWN OF BROOKLINE**

WHEREAS, Frederick Law Olmsted left the people of the nation and of The Commonwealth of Massachusetts a magnificent historic, cultural and environmental legacy of public parks and open spaces;

WHEREAS, in January of 1984 the Commonwealth of Massachusetts committed itself to reclaiming that legacy by creating the Olmsted Historic Landscape Preservation Program and the “Emerald Necklace Master Plan” of 1990, updated in 2001; and, the Commonwealth’s mission is to preserve significant historic landscapes and to encourage the public’s appreciation, understanding, wise use and maintenance of this historic legacy;

WHEREAS, the health, safety and quality of life of the residents and communities of Boston and Brookline have been threatened by and subject to flooding, impaired water quality and degraded habitat related to the Muddy River in the Boston Park System known as the Emerald Necklace;

WHEREAS, in accordance with a Memorandum of Agreement (“MOA”), dated June 8, 1999, the City of Boston and the Town of Brookline---accepted responsibility for the implementation of the Emerald Necklace Environmental Improvements Master Plan and the Phase I Muddy River Flood Control, Water Quality, Landscape Restoration and Habitat Enhancement Project (EOEA# 11865) (the master plan and the projects contained therein and Phase I for the area between the Charles River and Perkins Street by Jamaica Pond collectively referred to as the “Project”, and the first portion of Phase I referred to as “Charlesgate”);

WHEREAS, the goals of the Project include, but are not limited to, flood control, water quality improvements, habitat enhancements and historic preservation of the Project area, which includes the parkways that surround the Project and the storm water drainage systems that serve it and are within the care, custody and control of each of the signatories to this Memorandum of Agreement;

¹ The Department of Conservation and Recreation is the successor agency to both the Department of Environmental Management and the Metropolitan District Commission pursuant to Chapters 26 and 41 of the Acts of 2003.

WHEREAS, the parties recognize that the unique nature of this historic landscape located in multiple jurisdictions offers the parties a unique opportunity to work together cooperatively to ensure outstanding stewardship of the entire Project area;

WHEREAS, the Executive Office of Environmental Affairs (“EOEA”), the Department of Environmental Management, the Massachusetts Emergency Management Agency, the Boston Water and Sewer Commission, the Town of Brookline (“Town”) and the City of Boston (“City”) committed to a Memorandum of Understanding, dated November 4, 1999, concerning the funding and administering of the planning, permitting, and design of Phase I of the Project and the construction and implementation of Charlesgate, and in which the City and Town accepted responsibility for their respective shares of future maintenance and management activities, including the implementation of best management practices, which are identified in a maintenance and management plan, submitted jointly by the City and the Town to the Secretary of Environmental Affairs, and reviewed as part of the review for adequacy of the environmental impact report pursuant to the Massachusetts Environmental Policy Act (“MEPA”), sections 61-62H of Chapter 30 of the General Laws and its associated regulations, and which maintenance and management plan is attached hereto and incorporated herein (the “Plan”);

WHEREAS, pursuant to MEPA the Secretary of Environmental Affairs issued a certificate, dated May 1, 2003 reaffirming that maintenance and management are key to ensuring that the Project meets its long-term goals and that the significant public investment in the project is adequately protected; and the certificate further acknowledges the need and requirement to clearly define the structure, roles and responsibilities, and develop adequate enforceable commitments for the short-term and long-term maintenance and management of the Project area to protect the substantial investment, both the incurred and anticipated, of federal, state, and local public funds to implement the Project, for which the state is assuming most of the City’s and the Town’s share of the non-federal portion of the capital costs of the Project in recognition of the commitment by the City and Town to the implementation of such long-term maintenance and management obligations;

WHEREAS, the Division of Conservation and Recreation (“DCR”) also recognizes the critical importance of maintenance and management of the Project area and is committed to maintaining and managing the parkways and other areas within and abutting the Project area that are subject to its care, custody and control to the same standard to which the City and the Town are obligated to maintain the areas subject to their respective care, custody and control;

WHEREAS, the Secretary of Environmental Affairs required the establishment, pursuant to the Final Record of Decision on the Phase One Waiver concerning Charlesgate, of an independent oversight committee known as the Muddy River Restoration Project Maintenance and Management Oversight Committee (“MMOC”);

WHEREAS, the Emerald Necklace Conservancy is a non profit corporation organized and existing for the purpose of contributing to the protection, restoration and preservation of the landscape, waterways and parkways of the Emerald Necklace park system as special places for people to visit and enjoy;

WHEREAS, the signatories to this Memorandum of Agreement (together, the “parties”) firmly believe that ongoing coordination and cooperation among the parties, the development of public-private partnerships, fostering public education and participation and the implementation of effective short- and long-term maintenance and management systems are critical components to ensuring effective stewardship of the Project area and the preservation of this significant and historic public resource;

WHEREAS, the parties agree that proper maintenance and management of the Project area are critical for achieving all of the project goals, as absent these elements, sediment will quickly reaccumulate in the river, degrading water quality and wildlife habitat and endangering the historic landscape with the direct threat of invasive species and the indirect threat of benign neglect;

WHEREAS, the parties believe it is appropriate to recognize and outline their respective roles and responsibilities relative to maintenance and management of the Project area to ensure the preservation and protection of this unique Olmsted park system;

NOW, THEREFORE, in order to clearly define the roles and responsibilities of the parties to this Memorandum of Agreement for maintenance and management activities associated with the Project area, the parties agree as follows:

1. Purpose.

The parties to this Memorandum of Agreement concerning the Project (the “Agreement”) hereby each commit to:

- (a) protect the substantial public investment in and to restore, improve, and provide proper stewardship for the natural, recreation, and cultural resources in the Project area;
- (b) comply with state, federal and local laws and permits, and the conditions and requirements of all existing and anticipated state and federal project agreements associated with the Project;
- (c) make clear the roles and responsibilities for the implementation of the required maintenance and management plan in a transparent and comprehensive manner;
- (d) establish a framework for ongoing, public participation and evaluation of the progress on the implementation of the maintenance and management plan and associated activities both in the short- and long-term;
- (e) foster mechanisms to create and maintain public-private partnerships to support the stewardship and improvement of the natural, recreational and cultural resources;
- (f) wherever possible, put aside jurisdictional barriers and boundaries and work collaboratively to implement the maintenance and management obligations of the various public landowners with respect to the Project area in a seamless and transparent manner,

and to respect both the specific processes of and the spirit of this unique inter-governmental agreement which may serve as a model for other multi-governmental projects for decades to come; and

- (g) maintain open and consistent communication among themselves regarding any matter which affects the Project or the Project area.

2. Maintenance and Management.

The parties recognize and agree that a substantial public investment is being made in the Project and that the long-term success of the Project is dependant upon responsible and effective stewardship of the entire Project area and maintenance and management in conformance with the standards detailed in and the specific provisions of the maintenance and management plan submitted by the City and Town, and reviewed and deemed adequate by the Secretary of Environmental Affairs (“Plan”). Essential measures in this stewardship include commitments to implementation and maintenance of storm-water best management practices, historic preservation and maintenance of project infrastructure and parklands and parkways. Therefore, the parties hereby agree to the following with respect to maintenance and management of the Project area:

- (a) The parties agree that the parklands within the Project area shall be maintained and managed in accordance with the standards detailed in and the specific provisions of the Plan.. That portion of the Plan specifically pertaining to parklands is attached hereto and incorporated herein as Appendix A to this Agreement.
- (b) The parties agree that the parkways and roadways within the Project area shall be maintained and managed in accordance with the standards detailed in and the specific provisions of the Plan. That portion of the Plan, specifically pertaining to parkways and roadways is attached hereto and incorporated herein as Appendix B to this Agreement.
- (c) The parties agree that the stormwater drainage system within the Project area shall be maintained and managed in accordance with the standards detailed in and the specific provisions of the Plan. That portion of the Plan specifically pertaining to stormwater drainage is attached hereto and incorporated herein as Appendix C to this Agreement.
- (d) The City and the Town shall each implement the maintenance and management obligations stated in the Plan, any conditions contained in relevant MEPA certificates of the Secretary, any Section 61 findings issued pursuant to MEPA, and the requirements of any permit or approval issued in connection with the Project, with respect to those portions of the Project area that are within their respective care, custody or control.
- (e) Compliance with the Plan by the City and by the Town shall be incorporated as conditions of any contract for state financial assistance associated with the Project, and any permits and approvals granted by any state agency with respect to the Project;

- (f) Compliance with the Plan by the City and by the Town shall be considered independent legal obligations, each of which shall be specifically enforceable by the Commonwealth, and also by any state agency to the extent that compliance with the Plan or any part of it is a condition of a permit or approval issued by that agency, and such rights of specific enforcement shall exist regardless of the availability of funds or appropriations by either the City or the Town.
- (g) In a manner consistent with the practices used by the City and the Town under the Plan, DCR shall maintain and manage the parklands, parkways, storm water drains and other infrastructure within or affecting the Project area that are under its care, custody and control, and in doing so shall implement the maintenance and management standards and practices set forth in the Plan.
- (h) The Town, the City and DCR agree to work cooperatively to ensure consistent and seamless maintenance and management of those portions of Project area within their respective care, custody and control, and the ENC and the MMOC agree to work cooperatively with them to achieve these goals.
- (i) The Town, the City and DCR each agree to provide sufficient staffing to implement the maintenance and management standards set forth in the Plan for all portions of the Project area within their respective care, custody and control.
- (j) The parties agree to work cooperatively to urge other landowners, both public and private, which own or control either land or infrastructure which abuts or affects the Project area to implement maintenance and management practices which are consistent with those set forth in the Plan.

3. Creation of Cabinet and its Management Structure.

The parties recognize and agree that long-term success in fulfilling the Project goals cannot be achieved without open lines of communication and sharing of information among the parties to this Agreement and the public, coordination of activities across jurisdictional boundaries and appropriate staffing to implement the maintenance and management plan. To this end, the parties hereby establish a Management Cabinet (the “Cabinet”) to formalize a maintenance and management structure to oversee the Project in furtherance of these purposes and achieving and maintaining the long-term success of the Project.

- (a) The Cabinet shall serve primarily as a mechanism and forum for high-level management officials to discuss, consider, resolve and implement decisions made with respect to: the range of issues associated with maintenance and management, historic preservation, stewardship and performance standards, including the appropriate capital and operating funding; the implementation, review, potential modification, and enforcement of standards pertaining to these issues; achievements; ongoing cooperation in furtherance of implementing new knowledge and lessons learned in the Project area; and any needs for and potential assistance that could be provided by the parties.

- (b) The Cabinet shall be the forum through which the parties shall facilitate coordination of the implementation by the parties of the Plan, and address compliance of the parties with the Plan, including the standards specified therein. Notwithstanding the foregoing, the parties specifically recognize and agree that the Cabinet shall not administer or otherwise control the day-to-day management or operation of any parklands, including lands, facilities, parkways or water courses that are under the care, custody or control of either the City, the Town or DCR; it being expressly understood that such is reserved to the City, the Town and DCR, respectively.
 - (c) The Cabinet shall have five (5) members, the City, the Town, DCR, the ENC and the MMOC, each of which shall designate a representative to serve on the Cabinet. Each member of the Cabinet shall have one vote.
 - (d) The Cabinet shall hold meetings at least quarterly, and otherwise as reasonably requested by any party, and as otherwise needed. At least one meeting each year shall be an open and public meeting.
 - (e) A quorum necessary to conduct a meeting of the Cabinet shall consist of not less than four (4) of the members of the Cabinet. The parties shall make an effort to make all decisions by consensus; but in no event shall any decision of the Cabinet be made by vote of fewer than four (4) members.
 - (f) The MMOC representative shall preside over the meetings of the Cabinet. *(Please note that the MMOC proposes that it chair the meetings as a service to the Cabinet and for consistency since in its oversight role, it has the widest constituency, encompassing not only the specific organizations represented in its membership, but other park advocacy groups and the public at large as well. The MMOC does not consider that the proposal on this issue stated in the original draft of the MOA provides a workable arrangement.)*
4. Muddy River Restoration Project Maintenance and Management Oversight Committee (MMOC).

The parties agree that proper maintenance and management of the Project area are critical to achieving the Project goals, and that implementation of a continuing, independent oversight body for the Project is essential to meeting these goals consistently in both the short and the long-term and to protecting the significant public investment in the Project. The parties agree that the MMOC, referenced and described in the MEPA Certificate dated May 1, 2003, shall fulfill such a role in the project management structure associated with the Project.

Because the MMOC has the widest and most inclusive constituency of all the parties to this Agreement, serves as the formal vehicle for public participation in the Project, , provides ongoing independent evaluation of the Project and serves, when necessary, as an outspoken watchdog to ensure outstanding stewardship of the Project area, the MMOC has a unique and critically important function on the Cabinet. Therefore, the parties agree as follows:

- (a) In order to enable the MMOC to fulfill its function, the parties agree to communicate in good faith and to share directly with the MMOC all information and documentation relating to the Project that are either requested by the MMOC or recognized by another party to be relevant to the Project or the maintenance and management of the Project area, so that the MMOC may fulfill its function. The MMOC shall communicate and share information directly with all parties, so that the parties may fulfill their functions, including maintenance and management obligations as applicable. The MMOC shall inform the Cabinet of outstanding issues that require consideration and resolution.
- (b) The MMOC shall consist of a member (except as otherwise indicated) from each of the agencies and organizations listed in Paragraphs 4 (c) and 4(d) (or the designee from within that agency or organization). Members representing the organizations listed in this Paragraph 4(c) shall be voting members of the MMOC, and those representing the agencies listed in Paragraph 4(d) shall be non-voting ex officio members of the MMOC. The Secretary, in her discretion, may add or remove member agencies and organizations from the MMOC, and shall consider the recommendations of the MMOC itself with respect to organizations and agencies which should be represented on the MMOC.
- (c) Except for the Emerald Necklace Citizens Advisory Committee, each of the following organizations shall have one (1) representative on the MMOC who shall be a voting member of the MMOC:

- Boston GreenSpace Alliance
- Boston Society of Landscape Architects
- Brookline GreenSpace Alliance
- Charles River Watershed Association
- Emerald Necklace Conservancy
- The Fenway Alliance
- Massachusetts Audubon Society
- Muddy River Restoration Project Technical Advisory Committee

The Emerald Necklace Citizens Advisory Committee shall have four (4) representatives on the MMOC, which shall include representatives from Boston and from Brookline, and each such representative shall be a voting member of the MMOC.

- (d) Each of the following agencies and organizations shall have one (1) representative on the MMOC, who shall be a non-voting, ex officio member of the MMOC:

- Boston Landmarks Commission
- Boston Parks and Recreation Department
- Brookline Parks and Open Space Division
- Brookline Preservation Commission
- Massachusetts Emergency Management Agency
- Massachusetts Executive Office of Environmental Affairs
- Massachusetts Historic Commission

Representatives from appropriate divisions of the Massachusetts Department of Conservation and Recreation

- (e) Without limiting the role of the MMOC, the MMOC shall provide the primary forum and conduit for public participation in the independent review, oversight and decision-making process of the parties associated with the maintenance and management of the resources within the Project area. The MMOC shall endeavor to hold monthly meetings and additional meetings as necessary.
- (f) In implementing its role as described in this Paragraph 4, the MMOC shall have the following responsibilities: review and evaluate the implementation and progress of construction activities and maintenance and management standards; evaluate progress and provide independent oversight of short and long-term maintenance and management activities; provide independent review and comment concerning reports and filings related to the Project area; monitor and evaluate compliance with permit, contract and legal obligations associated with the Project, including Section 61 findings; promote coordination and communication concerning maintenance and management activities among the Parties and the public; encourage representation of a broad public constituency on the MMOC; serve as a conduit for public participation and access to information concerning maintenance and management of the Project area; and report frequently to the Cabinet any issues for its discussion and consideration.
- (g) The Town, the City and DCR or other appropriate state agency shall provide funding for the duration of the construction of the Project plus five years to support the activities of the MMOC. Funding shall be not less than \$35,000 per year from the City, \$20,000 per year from the Town, and \$20,000 per year from DCR. Funding for the MMOC shall be administered and distributed both in a manner and through a qualified organization acceptable to the governmental entities that are parties to this Agreement. Such parties recognize that at the time of execution of this Agreement, Mission Hill Main Streets is serving as the MMOC's fiscal agent and they agree that such organization is qualified and acceptable to serve in such capacity. The MMOC shall internally manage the funds through procedures established by the MMOC and overseen by its Steering Committee. The MMOC shall provide an annual financial report to MEPA, the City, the Town and DCR.

5. Role of the Emerald Necklace Conservancy.

- (a) The ENC shall use best efforts to work with the other parties to assess and identify annual funding necessary for the maintenance and management of the Project area, funding for the administration and activities, and to assist DCR, the City and the Town to secure the necessary annual funding for DCR's, the City's and the Town's maintenance and management and capital obligations.
- (b) The ENC will facilitate the development of partnerships among the Parties and non-profit organizations; act as a liaison with the cultural and educational institutions in the neighborhoods along the Muddy River; and develop and implement public education and

other programs to promote an understanding and appreciation of the landscape, waterways, parkways and features of the Emerald Necklace.

- (c) The ENC shall assist the Cabinet in its administration through, at the request of the Cabinet: assisting in convening meetings; identifying locations of Cabinet meetings; and disseminating materials relating to Cabinet meetings and activities.

6. Dispute Resolution.

In the event of a dispute related to this Agreement or the Project, the parties shall use the following as a condition precedent to any party pursuing other available remedies, including legal remedies. Notwithstanding the foregoing, the parties are committed to trying to resolve all issues that relate to this Agreement and the Project informally and expeditiously through the Cabinet, and agree that for the purposes of this Paragraph 6, there shall not be a dispute until such informal efforts though the Cabinet shall have been ineffective:

- (a) A party who believes a dispute exists (the “disputing party”) shall give written notice of such dispute in writing to the party or parties involved in the dispute (the “responding party” or the “responding parties”), and shall provide a copy of such notice simultaneously to each other party to this Agreement. Such notice shall clearly, though as briefly as practicable, state the substance and scope of the dispute, the disputing party’s position relative thereto, including legal and factual justifications therefore, the remedy sought, and any other pertinent matters.
- (b) The responding party or Parties shall respond in writing to the disputing party within ten (10) days of receiving such notice, and shall send a copy of such response to each of the other parties to this Agreement. Such writing shall clearly, though as briefly as practicable, state the responding party’s (of parties’) response to each of the items included in the disputing party’s writing, and any other pertinent matters.
- (c) A telephone conference shall be held within ten (10) days between representatives of the parties having decision-making authority regarding the dispute, to negotiate in good faith a resolution of the dispute.
- (d) If, within ten (10) business days after such telephone conference, the parties have not succeeded in negotiating a resolution of the dispute, the parties’ representatives shall submit the dispute to mediation by contacting the MA Office of Dispute Resolution (MODR), who will administer the mediation process. The fees of, and authorized expenses incurred by, the mediation shall be shared equally by the parties.
- (e) The parties hereby agree to mediate in good faith for a minimum period of ten (10) days from the actual commencement of the mediation. If the parties are not successful in resolving the dispute through mediation, then the parties may agree to submit the matter to binding arbitration, or either party may pursue other available remedies upon ten (10) days written notice to the other party specifying its intended course of action. Any

decision associated with the resolution of a dispute shall be presented and ratified at a meeting of the Cabinet.

- (f) The parties may mutually agree to extend any of the time periods stated herein.
- (g) The parties agree that the mediation provided for here is a compromise negotiation for purposes of all international, federal and state rules of evidence. The entire procedure will be confidential to the extent permitted by law. All conduct, statements, promises, offers, views and opinions, whether oral or written, made in the course of the mediation by any of the parties, their agents, employees, representatives or other invitees to the mediation and by the neutral, who is the parties' joint agent for the purpose of these compromise negotiations, are confidential and shall, in addition and where appropriate, be deemed to be privileged. Such conduct, statements, promises, offers, views and opinions shall not be discoverable or admissible for any purposes, including impeachment, in any litigation or other proceeding involving the parties and shall not be disclosed to anyone not an agent, employee, expert, witness, or representative for any of the parties. However, evidence otherwise discoverable or admissible in a later proceeding is not excluded from discovery or admission as a result of its use in the mediation. If not entirely enforceable, the parties intend that the court enforce this provision to the extent enforceable by such court.
- (h) The parties agree that nothing contained herein shall affect or limit, in any way, any party, as applicable, from independently exercising or enforcing its authority under any applicable statute, regulation or other provision of law that it is charged with administering.

7. U.S. Army Corps of Engineers Project Agreement Conditions.

The parties recognize that certain obligations and conditions associated with the Project must be fulfilled by certain parties independent of this memorandum as part of any project agreement for the Project with the United States Army Corp of Engineers and local, state and federal project permits. The parties agree, however, that fulfillment of those conditions and obligations (in force or as lawfully modified) by the relevant parties shall be considered binding maintenance and management obligations under this Agreement..

8. Rights and Liabilities of the Parties.

Nothing in this Agreement, except as expressly stated, shall be construed to diminish, enlarge or modify any right or liability of any of the parties, or create liability on the part of any public agency for the act or omission of another public agency or a private person. Nothing in this Agreement shall be construed to amend, repeal or otherwise alter the authority or jurisdiction of any public agency. Nothing in this Agreement , including any process established herein, shall be construed to amend, repeal or otherwise alter any mitigation commitment, obligation or requirement pursuant to MEPA.

9. Effective Date and Term.

The effective date of this Agreement shall be the date of execution by the last of the parties to sign. The Agreement shall remain in effect from the effective date and shall not expire until thirty (30) years from the completion date of the capital investments of the Project, unless the term is extended or modified with the unanimous agreement of all of the parties. This duration of the Agreement represents the currently estimated expected life of the capital investments implemented, if maintained as anticipated, as part of the Project.

**For the Executive Office of
Environmental Affairs:**

Secretary Ellen Roy Herzfelder

Date: _____

**For the Department of
Conservation and Recreation:**

Commissioner Katharine Abbott

Date: _____

**For the Boston Parks and
Recreation Department:**

Commissioner Antonia Pollack

Date: _____

**For the Brookline Public
Works Department:**

Commissioner Thomas DeMaio

Date: _____

For the MMOC:

Date: _____

For the ENC:

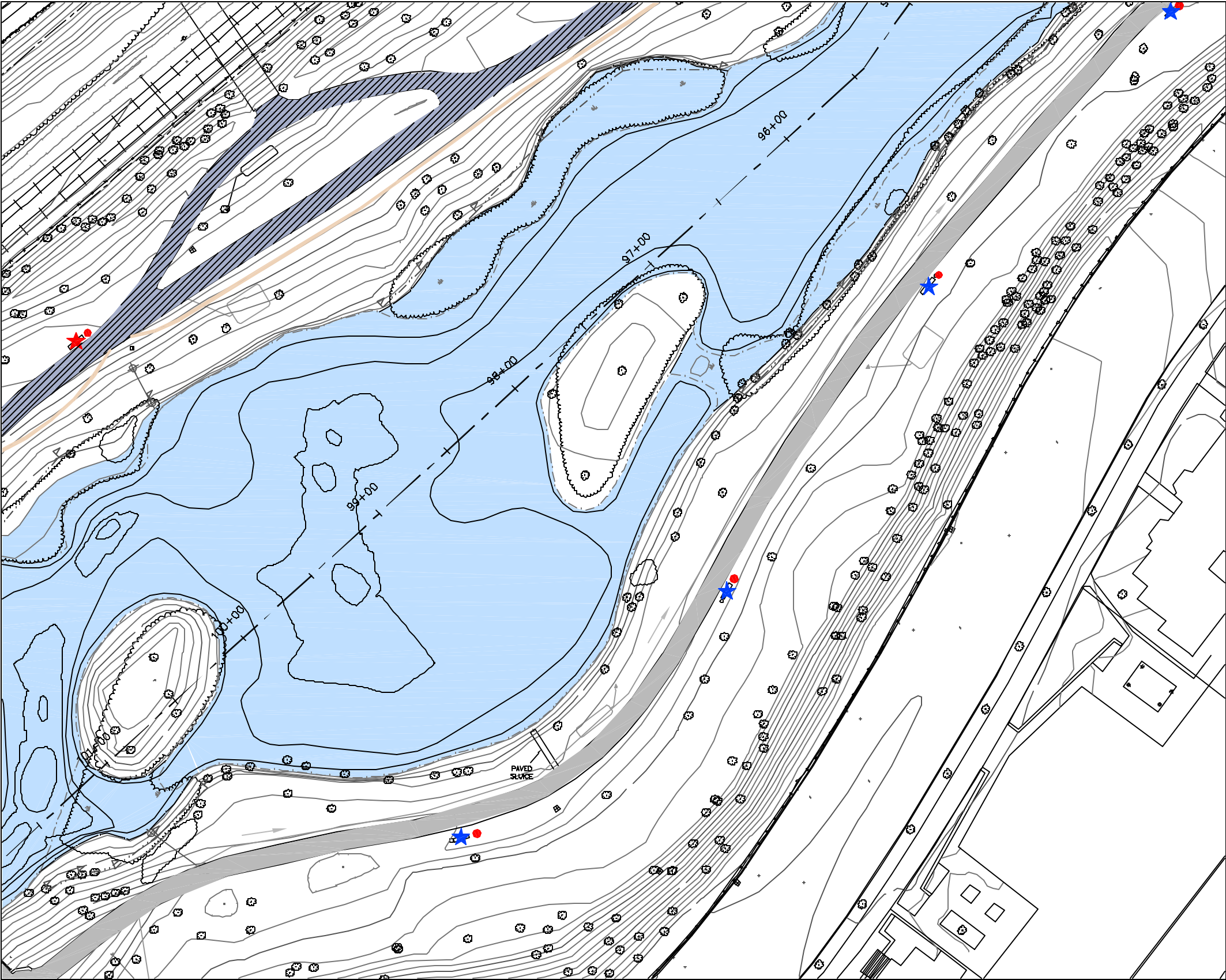
Date: _____

#00894181

**Appendix F: MUDDY RIVER RESTORATION PROJECT
INVENTORY AND ANALYSIS MAPS –
CIRCULATION & SITE FURNISHINGS**

MATCHLINE: SEE SHEET L25

MATCHLINE: SEE SHEET L27



MATCHLINE: SEE SHEET L28

MATCHLINE: SEE SHEET L21

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

GRAPHIC SCALE

NORTH

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE			
Inventory and Analysis CIRCULATION / SITE FURNISHING			

DRAWN BY		MC, MM		DRAWING NO.	
CHECKED BY		MP		L26	
DATE		11/21/00		SCALE	
				1"=60'	

Pressley Associates, Inc.
432 Columbia Street
Cambridge, MA 02141
Phone: (617) 491-5300
FAX: (617) 491-7502
Email: pressley@pressleyinc.com

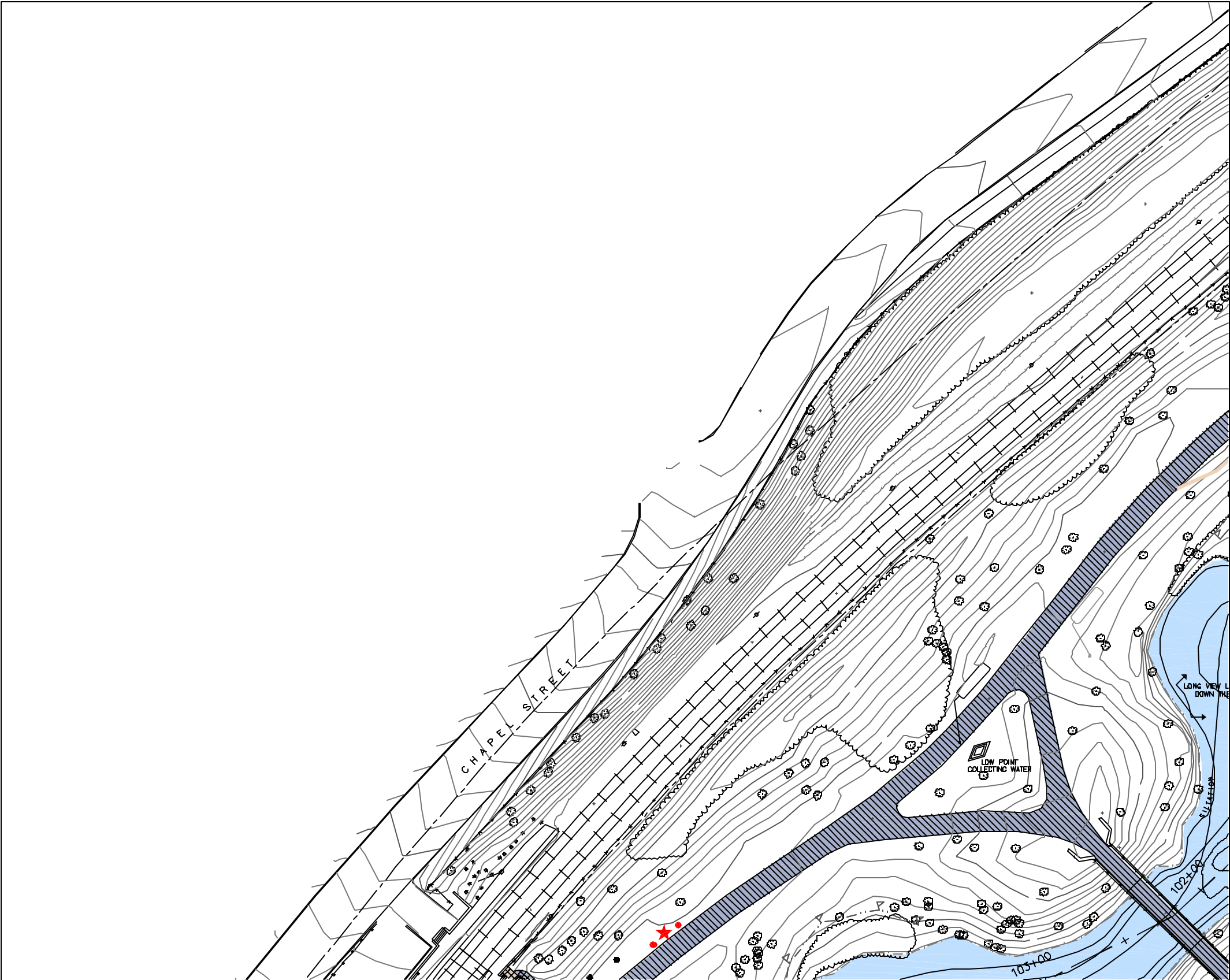
The Muddy River Restoration Project

Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

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Inventory and Analysis CIRCULATION / SITE FURNISHING			

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MATCHLINE: SEE SHEET L29

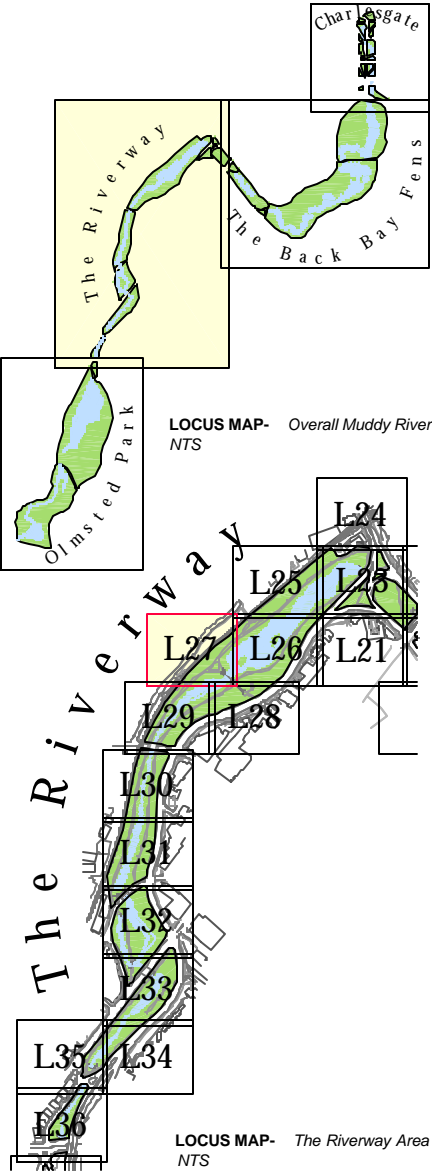
MATCHLINE: SEE SHEET L28

MATCHLINE: SEE SHEET L26

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INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE



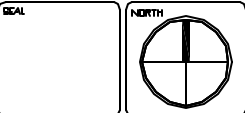
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NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING

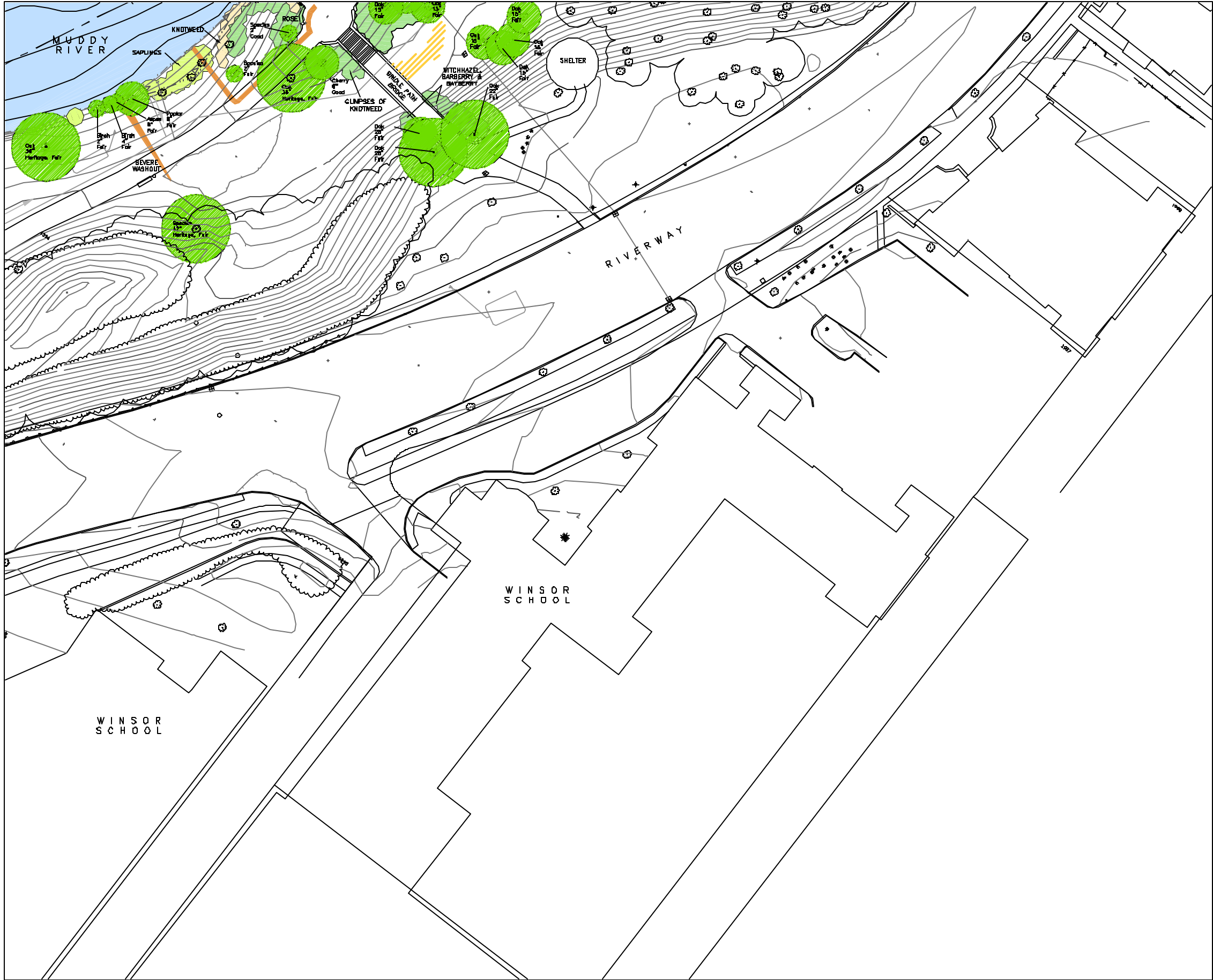


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DRAWING NO.
L27

MATCHLINE: SEE SHEET L29

MATCHLINE: SEE SHEET L27

MATCHLINE: SEE SHEET L26



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS

NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE
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SCALE
1"=80'

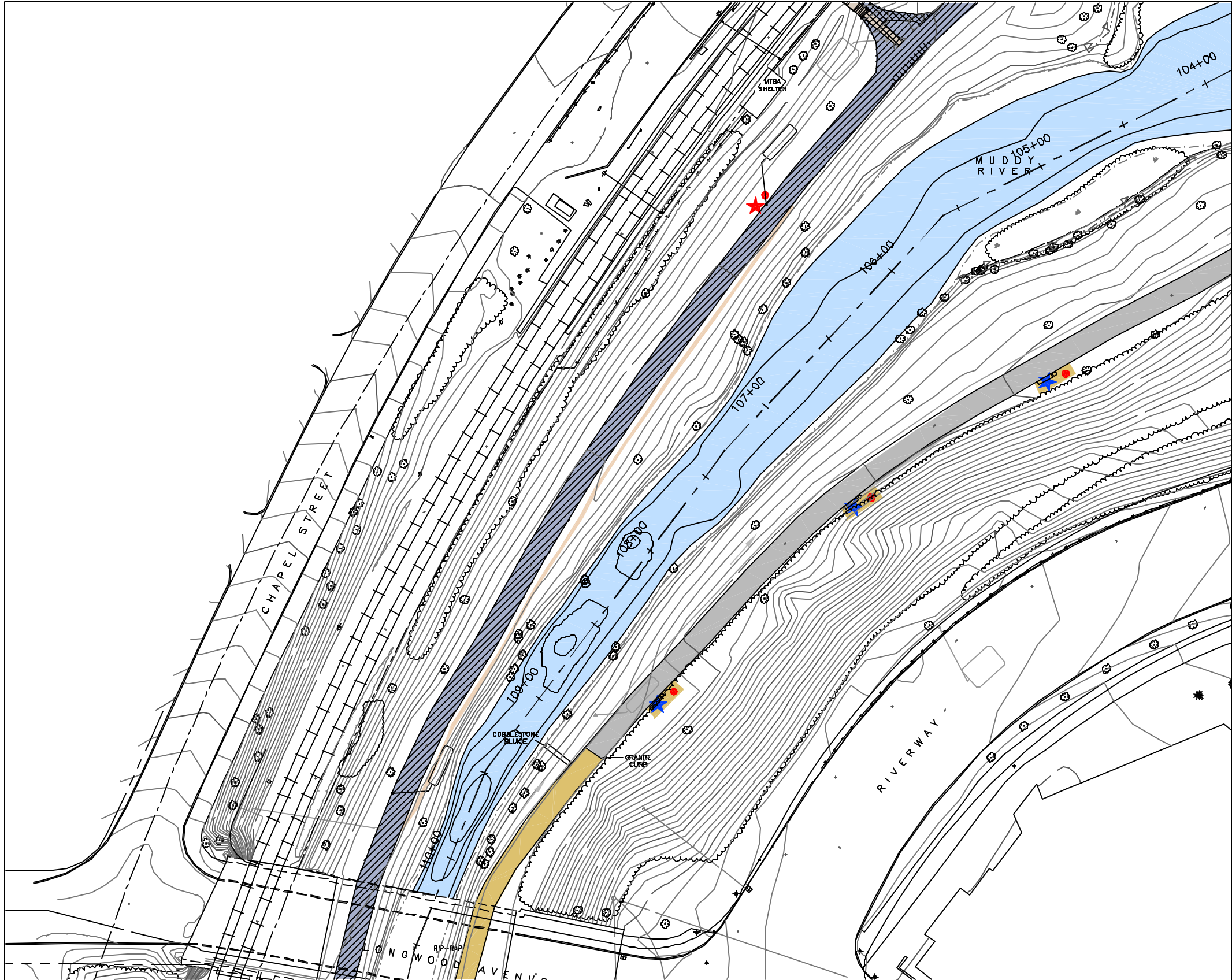
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DATE 11/21/00
SCALE 1"=80'

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L28

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Boston and Brookline, Massachusetts

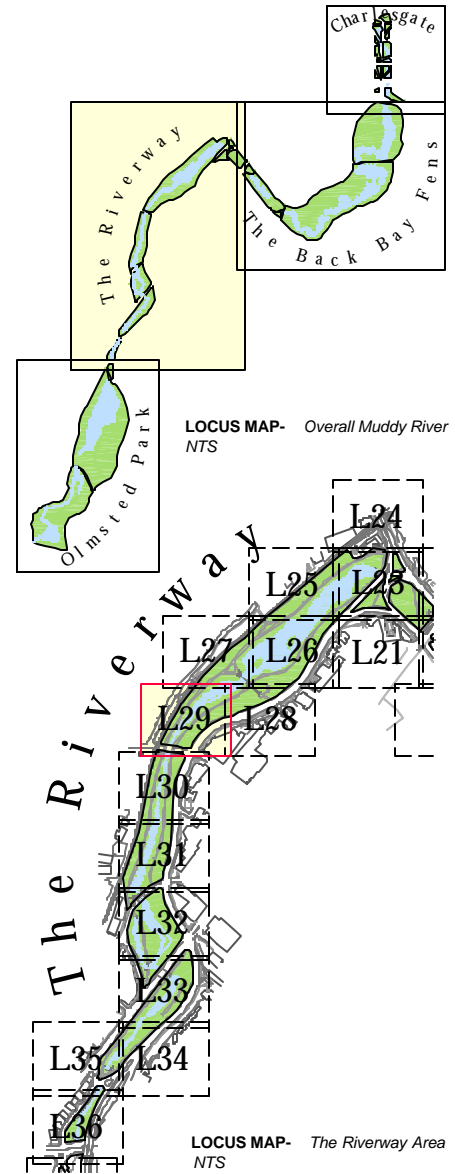


MATCHLINE: SEE SHEET L27

MATCHLINE: SEE SHEET L30

MATCHLINE: SEE SHEET L28

LEGEND	
INVENTORY AND ANALYSIS	
CIRCULATION/ PAVING	
CONCRETE SURFACE	
BITUMINOUS CONCRETE SURFACE	
STONEDUST SURFACE	
BRICK SURFACE	
ROLLED STONE SURFACE	
DESIRE LINES	
DEPRESSION ALONG PATHS	
SITE FURNISHINGS	
BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



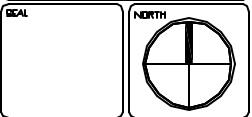
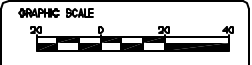
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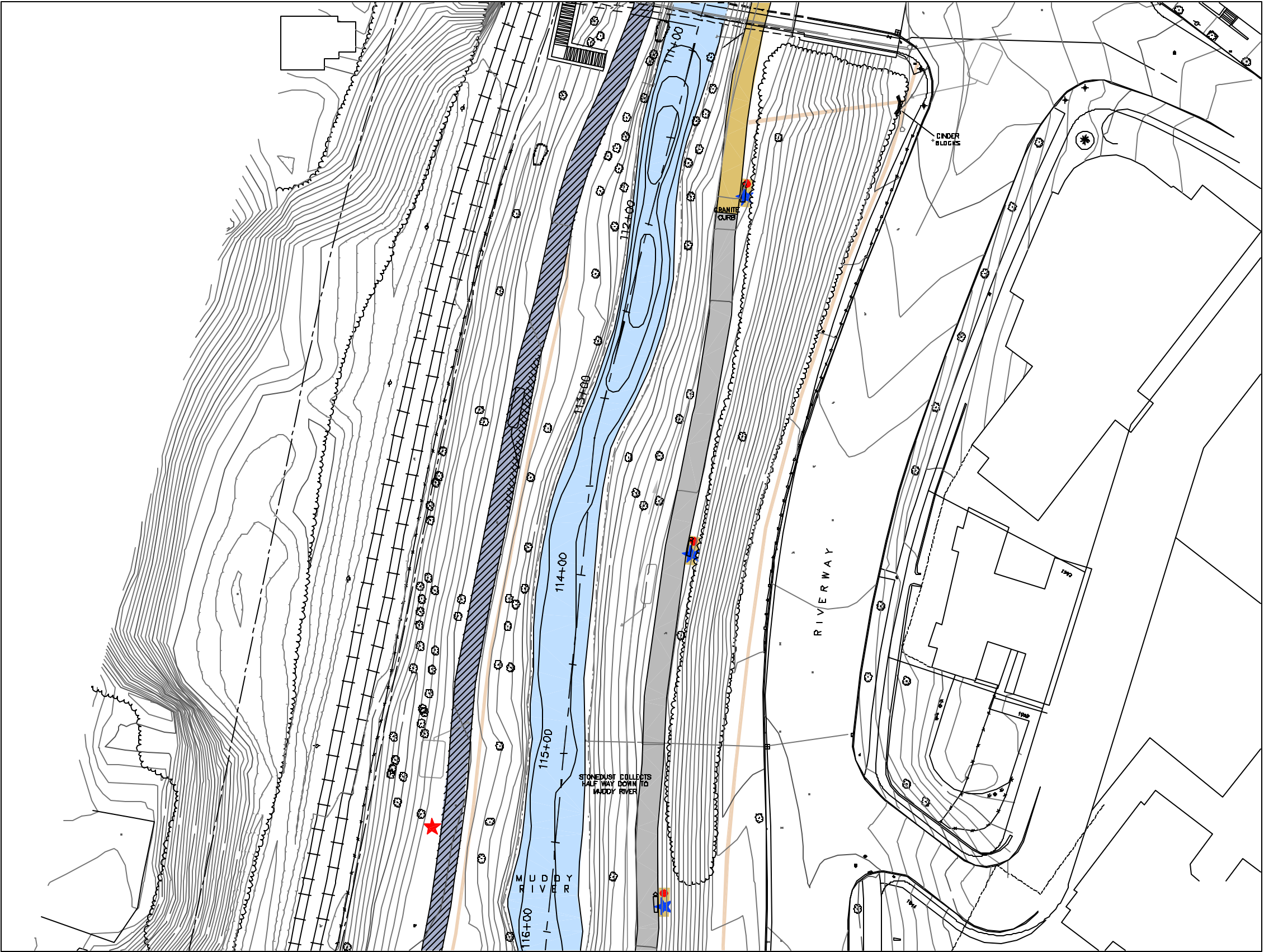
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NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.
L29

MATCHLINE: SEE SHEET L29



MATCHLINE: SEE SHEET L31

LEGEND
INVENTORY AND ANALYSIS

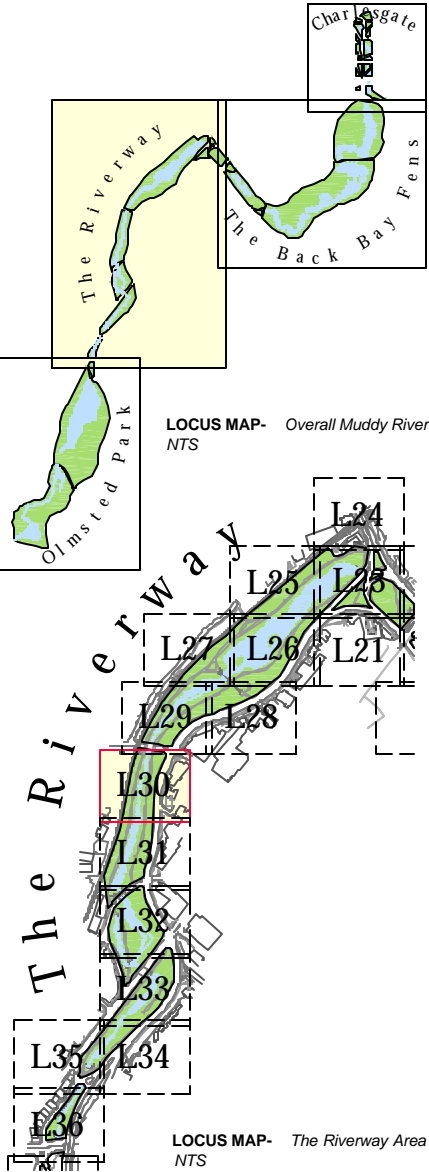
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STONEDUST SURFACE	[Pattern]	[Pattern]	[Pattern]
BRICK SURFACE	[Pattern]	[Pattern]	[Pattern]
ROLLED STONE SURFACE	[Pattern]	[Pattern]	[Pattern]

DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	[Symbol]
HISTORICAL BENCH STANDARD	[Symbol]
MOBILE TRASH RECEPTACLE	[Symbol]
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HISTORICAL LIGHT FIXTURE	[Symbol]



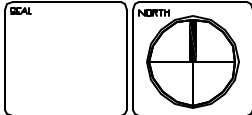
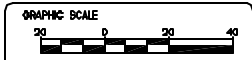
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REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

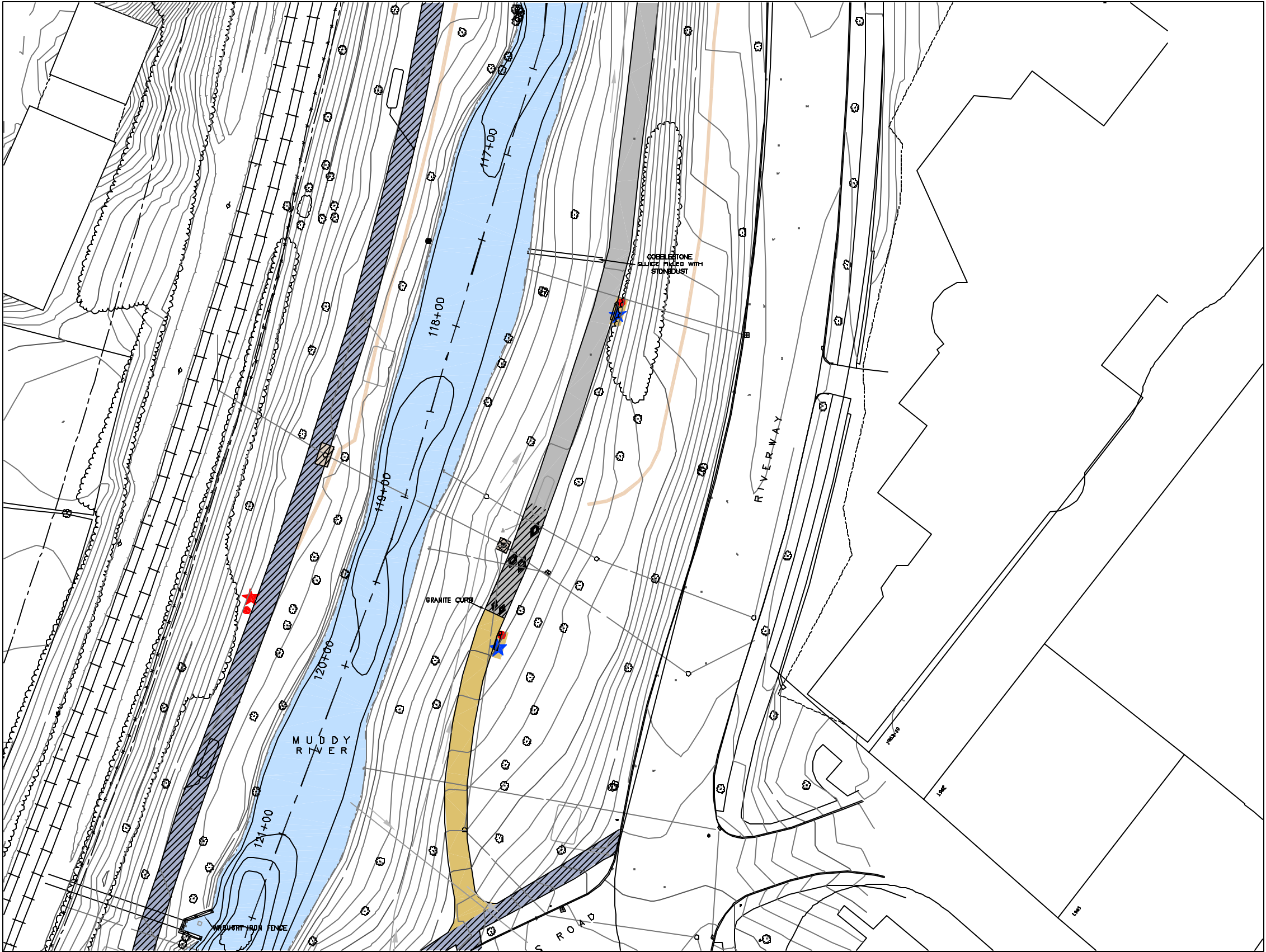
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Inventory and Analysis
**CIRCULATION /
SITE FURNISHING**



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CHECKED BY: MP
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DRAWING NO.
L30

MATCHLINE: SEE SHEET L30



MATCHLINE: SEE SHEET L32

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING

CONCRETE SURFACE

BITUMINOUS CONCRETE SURFACE

STONEDUST SURFACE

BRICK SURFACE

ROLLED STONE SURFACE

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)

HISTORICAL BENCH STANDARD

MOBILE TRASH RECEPTACLE

STATIONARY TRASH RECEPTACLE

HISTORICAL LIGHT FIXTURE

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
**CIRCULATION /
SITE FURNISHING**

GRAPHIC SCALE

SCALE

NORTH

DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

DRAWING NO.
L31

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The Muddy River Restoration Project

Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
**CIRCULATION /
SITE FURNISHING**

GRAPHIC SCALE

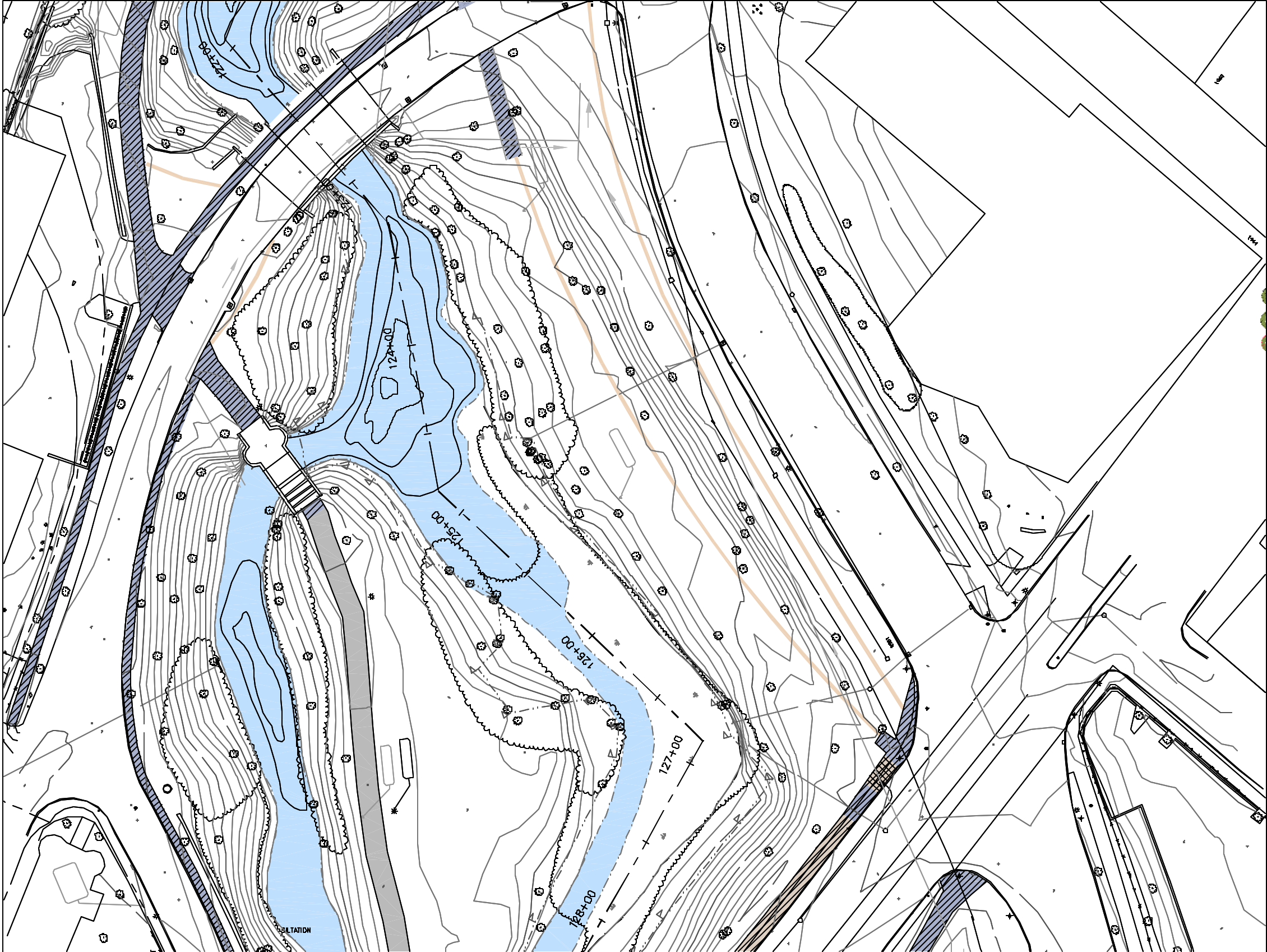
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NORTH

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CHECKED BY: MP
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SCALE: 1"=60'

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L31

MATCHLINE: SEE SHEET L31



MATCHLINE: SEE SHEET L33

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING

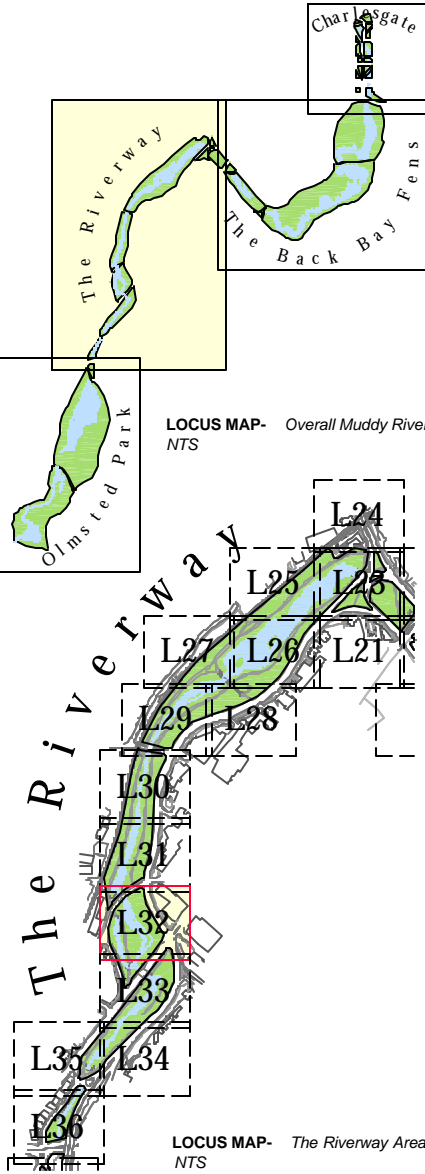
CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
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HISTORICAL LIGHT FIXTURE	



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Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION / SITE FURNISHING

GRAPHIC SCALE
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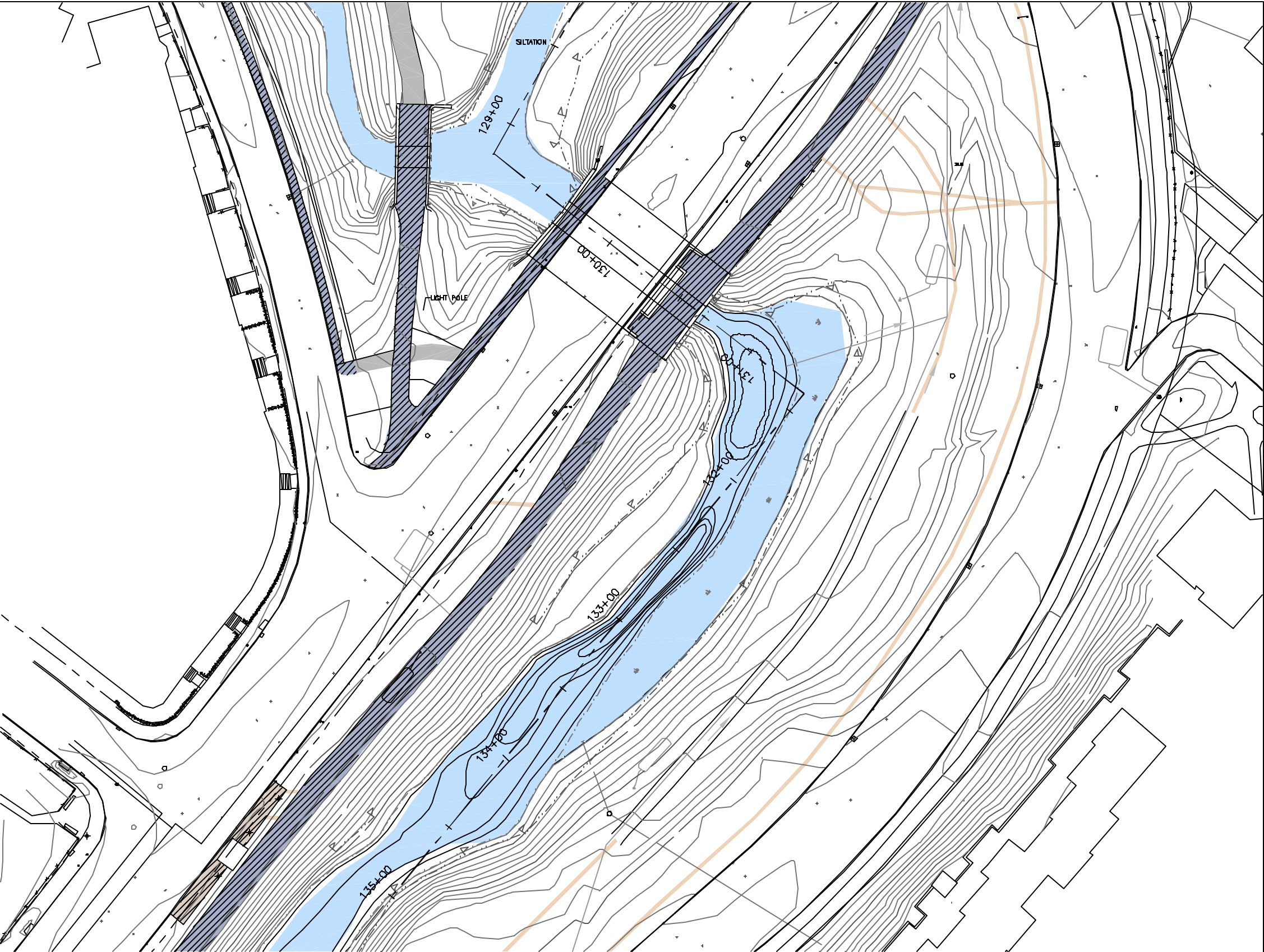
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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'

DRAWING NO.
L32

MATCHLINE: SEE SHEET L32



MATCHLINE: SEE SHEET L34

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE

DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING

GRAPHIC SCALE

0 20 40

SCALE

NORTH

DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'

DRAWING NO.

L33

Pressley Associates, Inc.
432 Columbia Street
Cambridge, MA 02141
Phone: (617) 491-5300
FAX: (617) 491-7502
Email: pressley@pressleyinc.com

The Muddy River Restoration Project

Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING

GRAPHIC SCALE

0 20 40

SCALE

NORTH

DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'

DRAWING NO.

L33



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS		
NO.	DATE	REMARKS

DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING

GRAPHIC SCALE

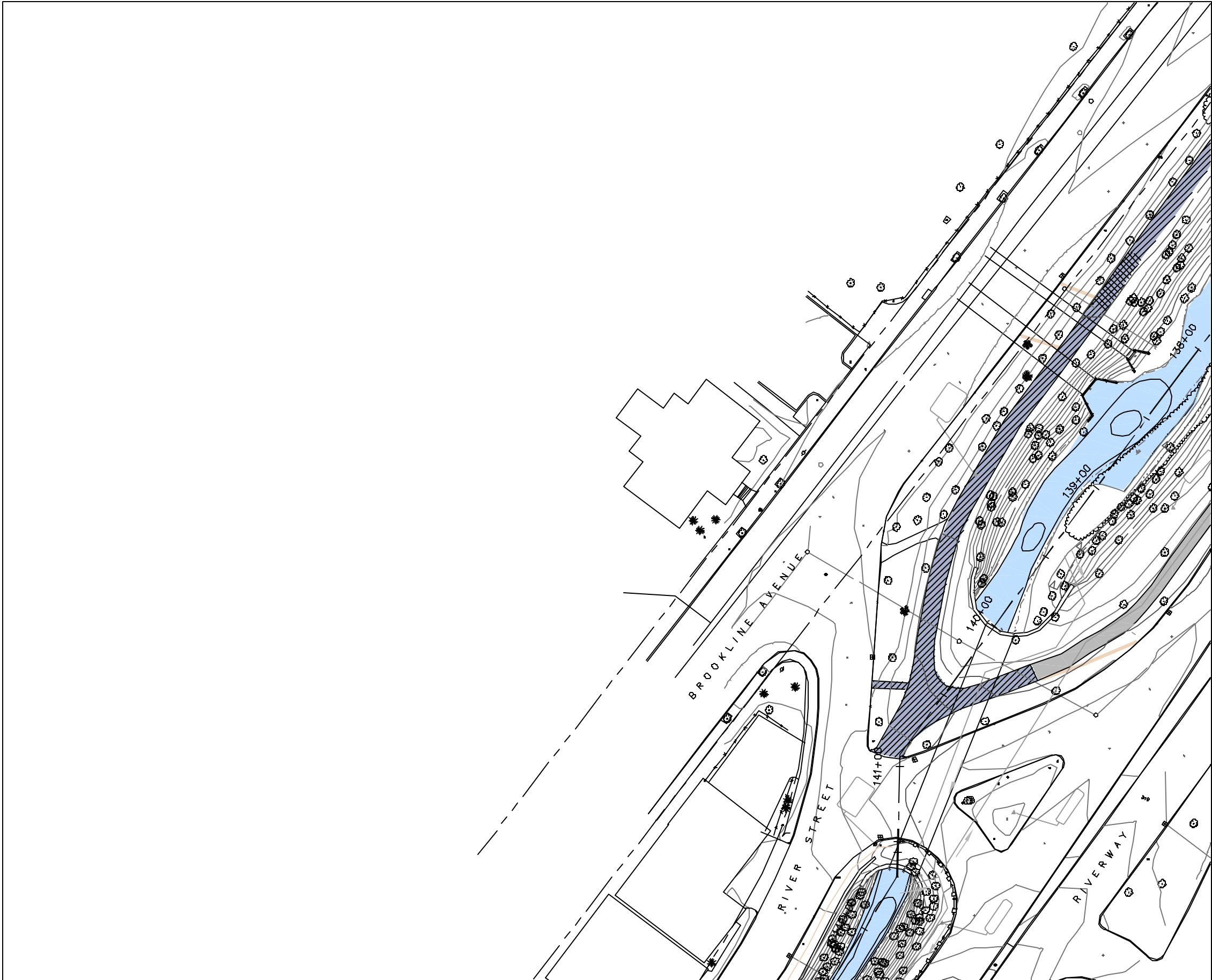
SCALE

NORTH

DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

DRAWING NO.

L34



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

GRAPHIC SCALE

NORTH

REVISIONS	
NO.	DATE

DRAWING TITLE	
Inventory and Analysis CIRCULATION / SITE FURNISHING	

DRAWING NO.	
L35	

MATCHLINE: SEE SHEET L35



MATCHLINE: SEE SHEET L37

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/PAVING

CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

HISTORICAL BENCH STANDARD - OLD	
HISTORICAL BENCH STANDARD - NEW	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS

NO.	DATE	REMARKS

DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING

GRAPHIC SCALE

SCALE

1"=60'

NORTH

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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

DRAWING NO.

L36



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING

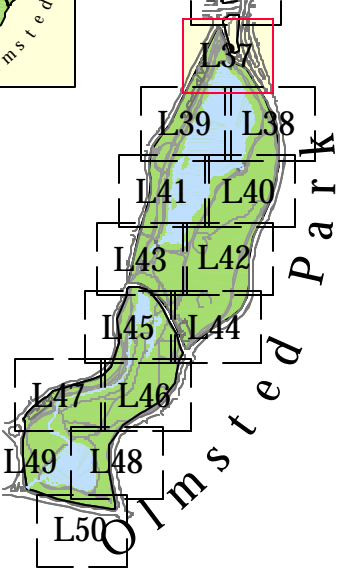
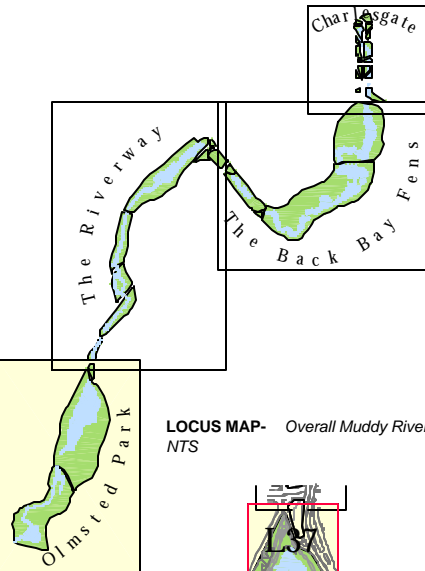
CONCRETE SURFACE		
BITUMINOUS CONCRETE SURFACE		
STONEDUST SURFACE		
BRICK SURFACE		
ROLLED STONE SURFACE		

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



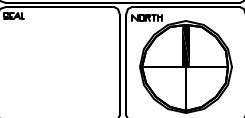
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Landscape Architects
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Phone: (617) 491-5300
FAX: (617) 491-7502
Email: pressley@pressleyinc.com

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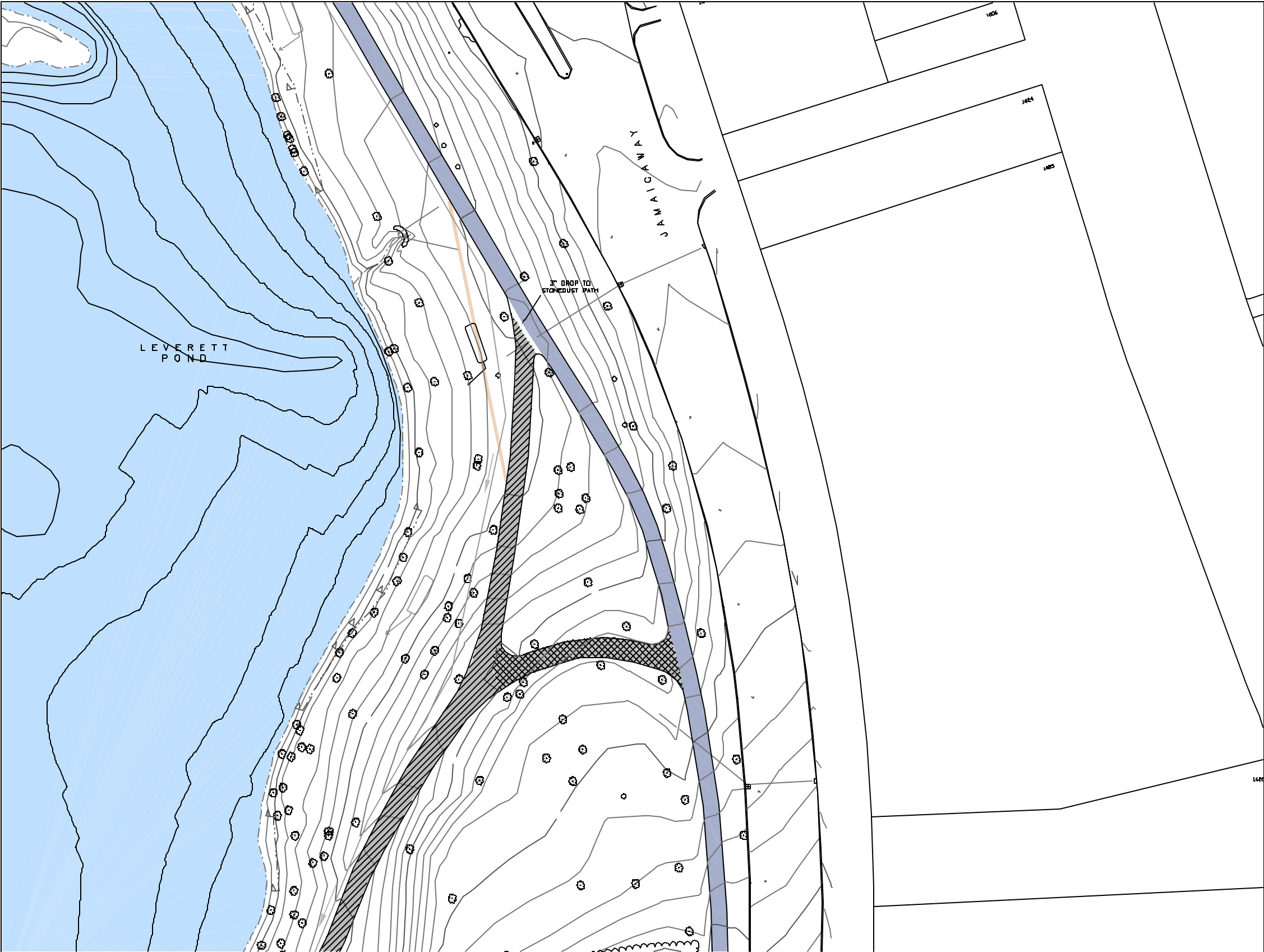
REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
**CIRCULATION /
SITE FURNISHING**



DRAWN BY: MC, VM	DRAWING NO.
CHECKED BY: MP	L37
DATE: 11/21/00	
SCALE: 1"=60'	

MATCHLINE: SEE SHEET L39



MATCHLINE: SEE SHEET L37

MATCHLINE: SEE SHEET L40

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING

CONCRETE SURFACE

BITUMINOUS CONCRETE SURFACE

STONEDUST SURFACE

BRICK SURFACE

ROLLED STONE SURFACE

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

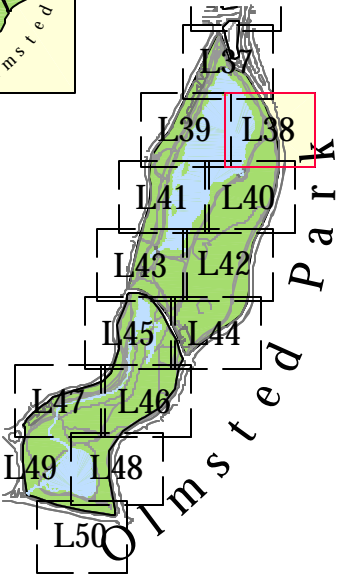
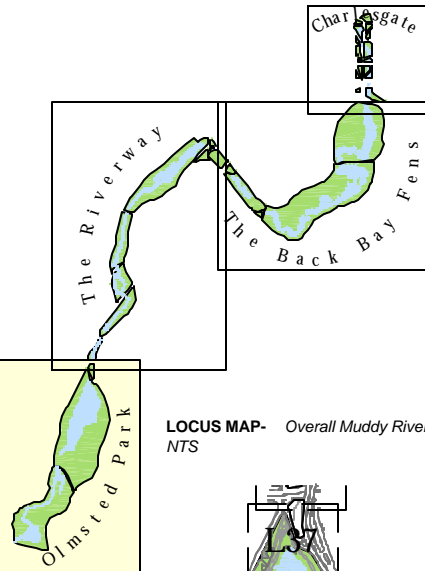
BENCH (NON-STANDARD)

HISTORICAL BENCH STANDARD

MOBILE TRASH RECEPTACLE

STATIONARY TRASH RECEPTACLE

HISTORICAL LIGHT FIXTURE



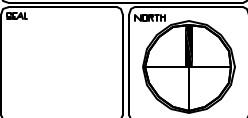
Pressley Associates, Inc.
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Email: pressley@pressleyinc.com

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NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, NM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L38



MATCHLINE: SEE SHEET L41

MATCHLINE: SEE SHEET L40

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING

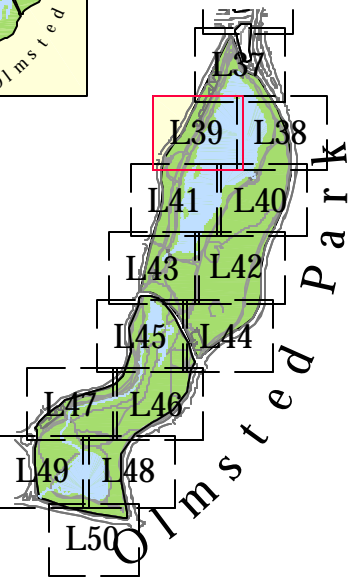
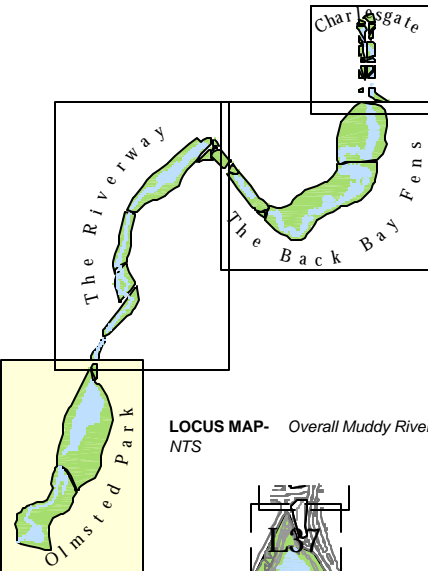
CONCRETE SURFACE		
BITUMINOUS CONCRETE SURFACE		
STONEDUST SURFACE		
BRICK SURFACE		
ROLLED STONE SURFACE		

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



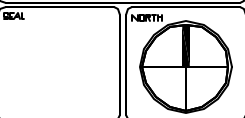
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Email: pressley@pressleyinc.com

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REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
**CIRCULATION /
SITE FURNISHING**

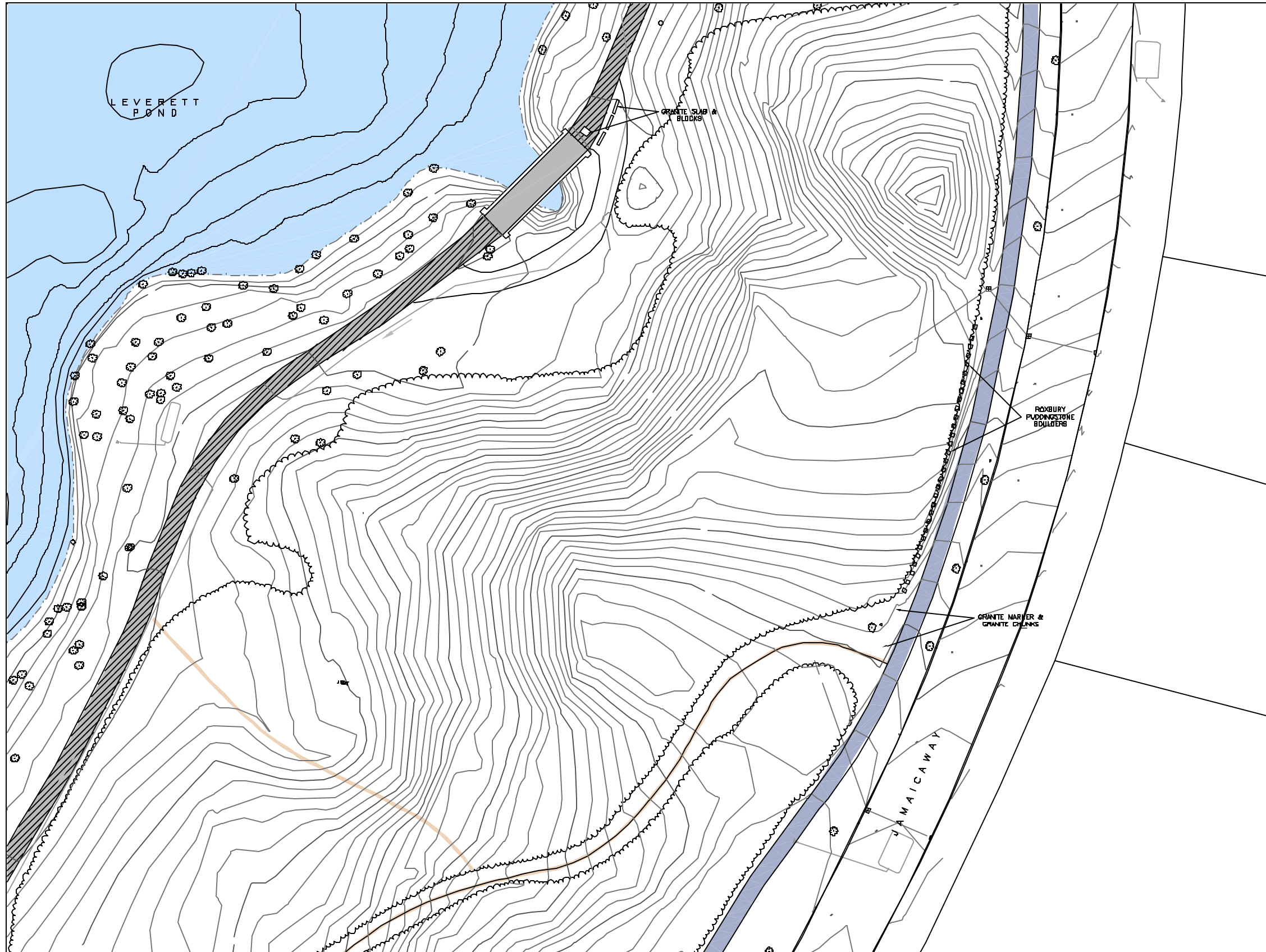


DRAWN BY: MC, NM	DRAWING NO.
CHECKED BY: MP	L39
DATE: 11/21/00	
SCALE: 1"=60'	

MATCHLINE: SEE SHEET L41

MATCHLINE: SEE SHEET L39

MATCHLINE: SEE SHEET L38



MATCHLINE: SEE SHEET L42

LEGEND
INVENTORY AND ANALYSIS

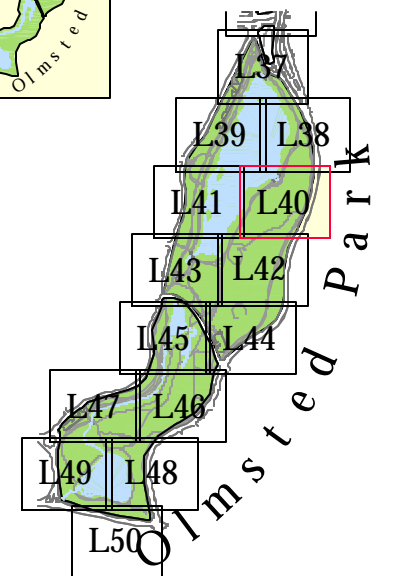
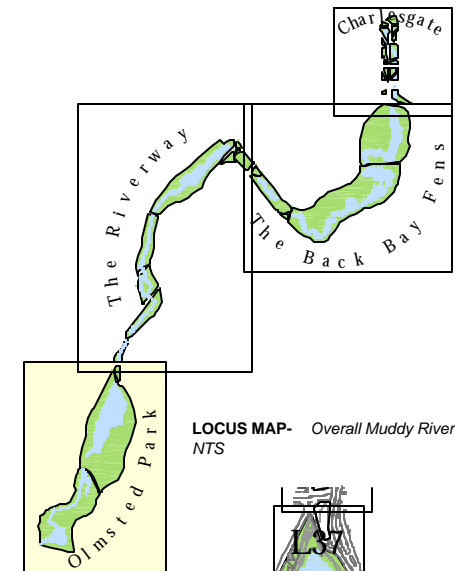
CIRCULATION / PAVING

CONCRETE SURFACE	[Pattern]	[Pattern]	[Pattern]
BITUMINOUS CONCRETE SURFACE	[Pattern]	[Pattern]	[Pattern]
STONEDUST SURFACE	[Pattern]	[Pattern]	[Pattern]
BRICK SURFACE	[Pattern]	[Pattern]	[Pattern]
ROLLED STONE SURFACE	[Pattern]	[Pattern]	[Pattern]

DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	[Symbol]
HISTORICAL BENCH STANDARD	[Symbol]
MOBILE TRASH RECEPTACLE	[Symbol]
STATIONARY TRASH RECEPTACLE	[Symbol]
HISTORICAL LIGHT FIXTURE	[Symbol]



LOCUS MAP- NTS
Olmsted Park

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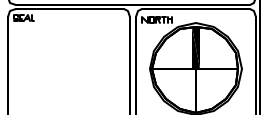
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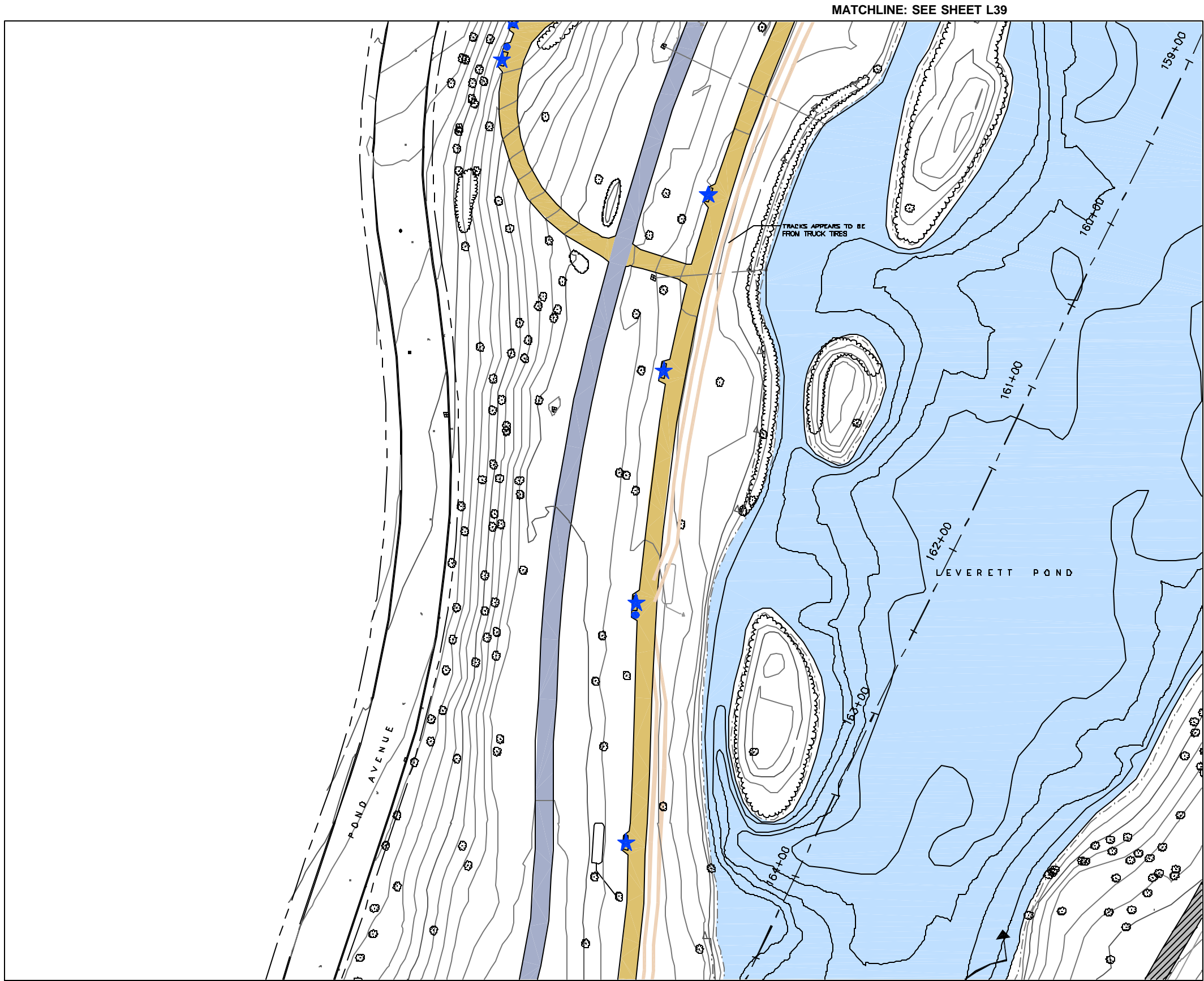
REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING

GRAPHIC SCALE
0 20 40



DRAWN BY: MC, N/A
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.: **L40**



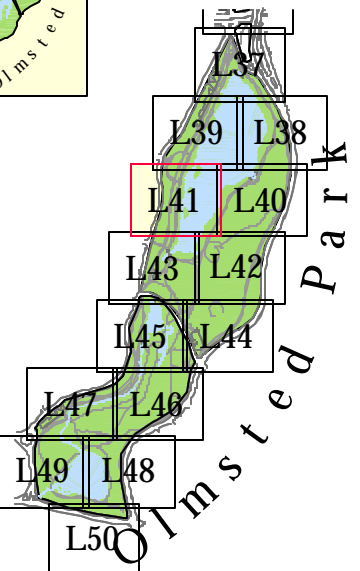
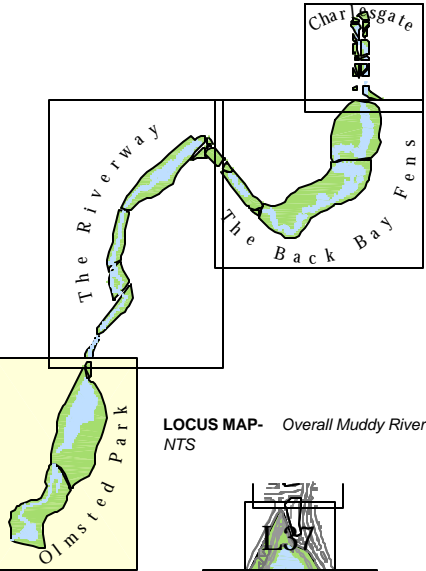
MATCHLINE: SEE SHEET L43

MATCHLINE: SEE SHEET L42

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE



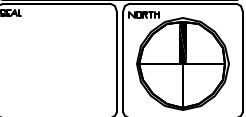
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FAX: (617) 491-7502
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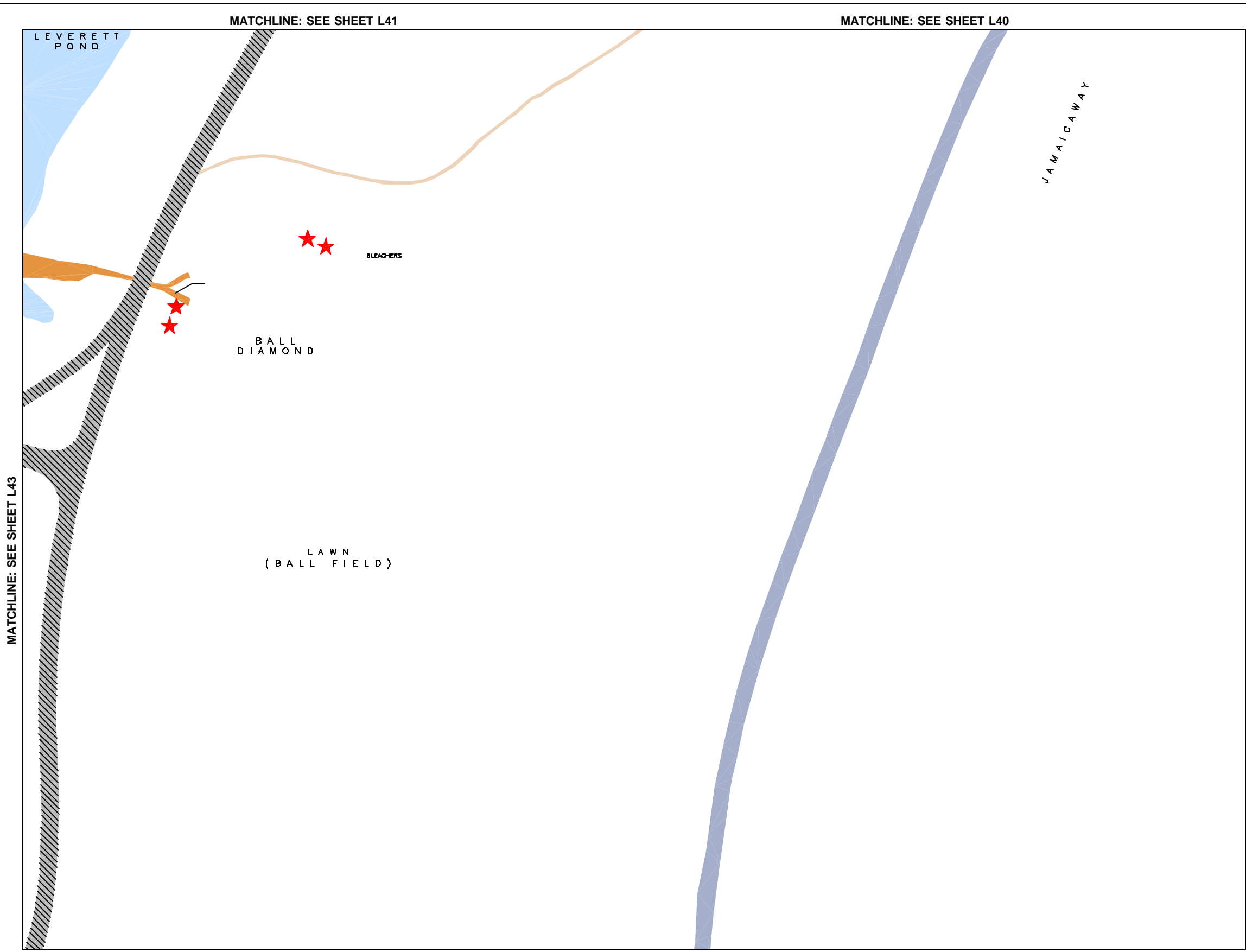
Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



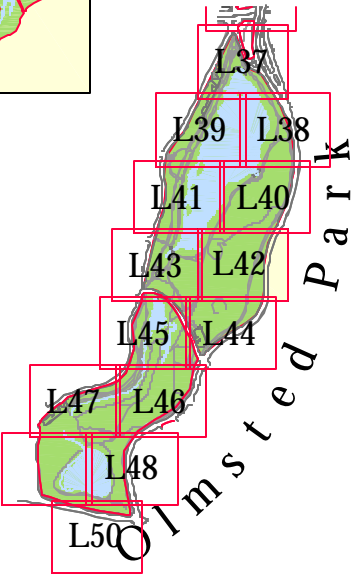
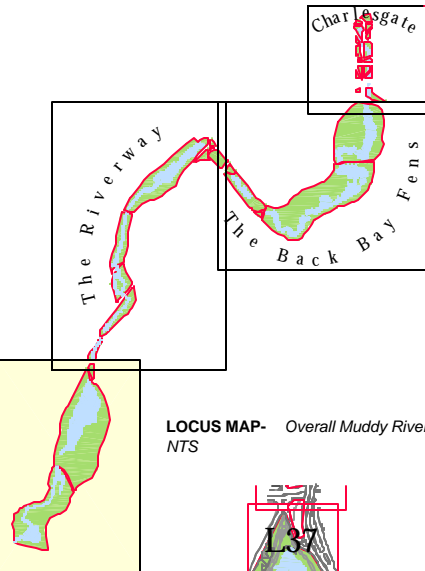
DRAWN BY: M.C. M4
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L41



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE



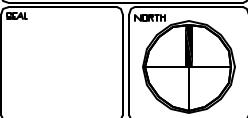
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Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	8/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



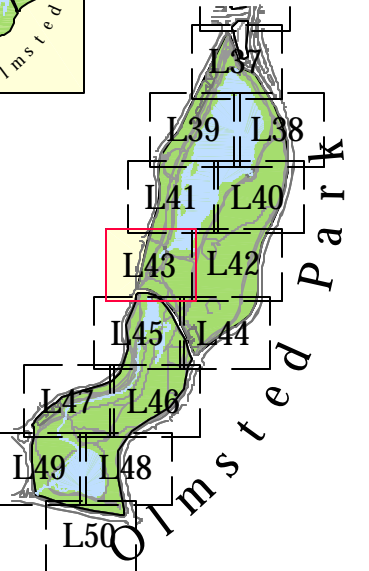
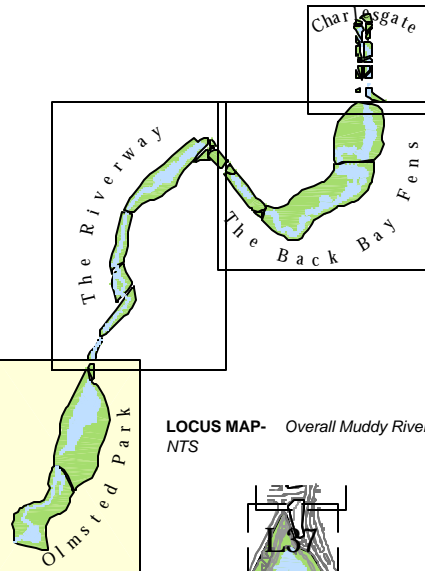
DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.:
L42



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
HISTORICAL BENCH STANDARD - OLD
HISTORICAL BENCH STANDARD - NEW
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE



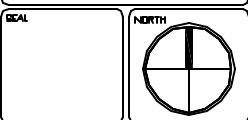
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FAX: (617) 491-7502
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The Muddy River Restoration Project

Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, LM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L43



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/PAVING

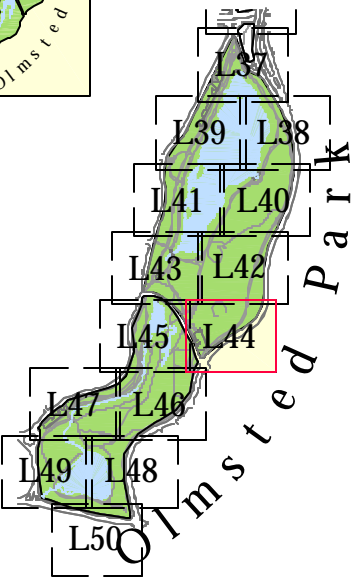
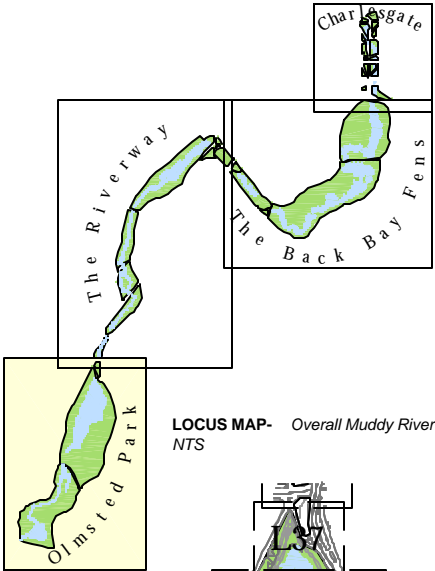
CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



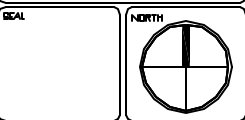
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FAX: (617) 491-7502
Email: pressley@pressleyinc.com

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REVISIONS		
NO.	DATE	REMARKS
A	8/1/01	

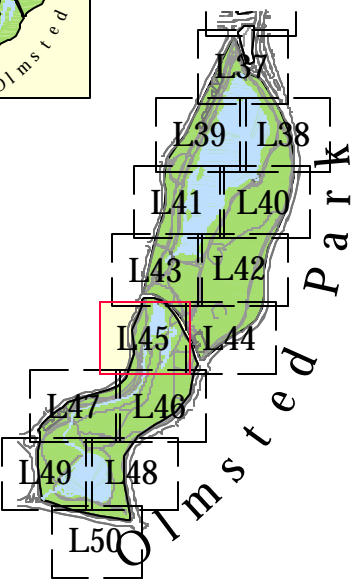
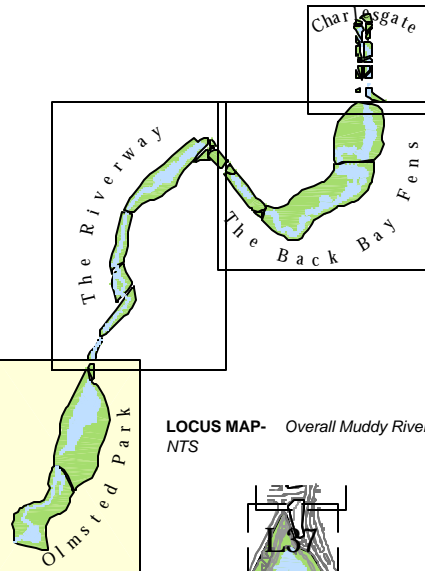
DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, MM	DRAWING NO. L44
CHECKED BY: MP	
DATE: 11/21/00	
SCALE: 1"=80'	



LEGEND	
INVENTORY AND ANALYSIS	
CIRCULATION/ PAVING	
CONCRETE SURFACE	
BITUMINOUS CONCRETE SURFACE	
STONEDUST SURFACE	
BRICK SURFACE	
ROLLED STONE SURFACE	
DESIRE LINES	
DEPRESSION ALONG PATHS	
SITE FURNISHINGS	
BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



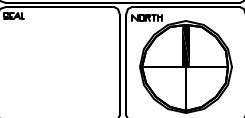
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NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING

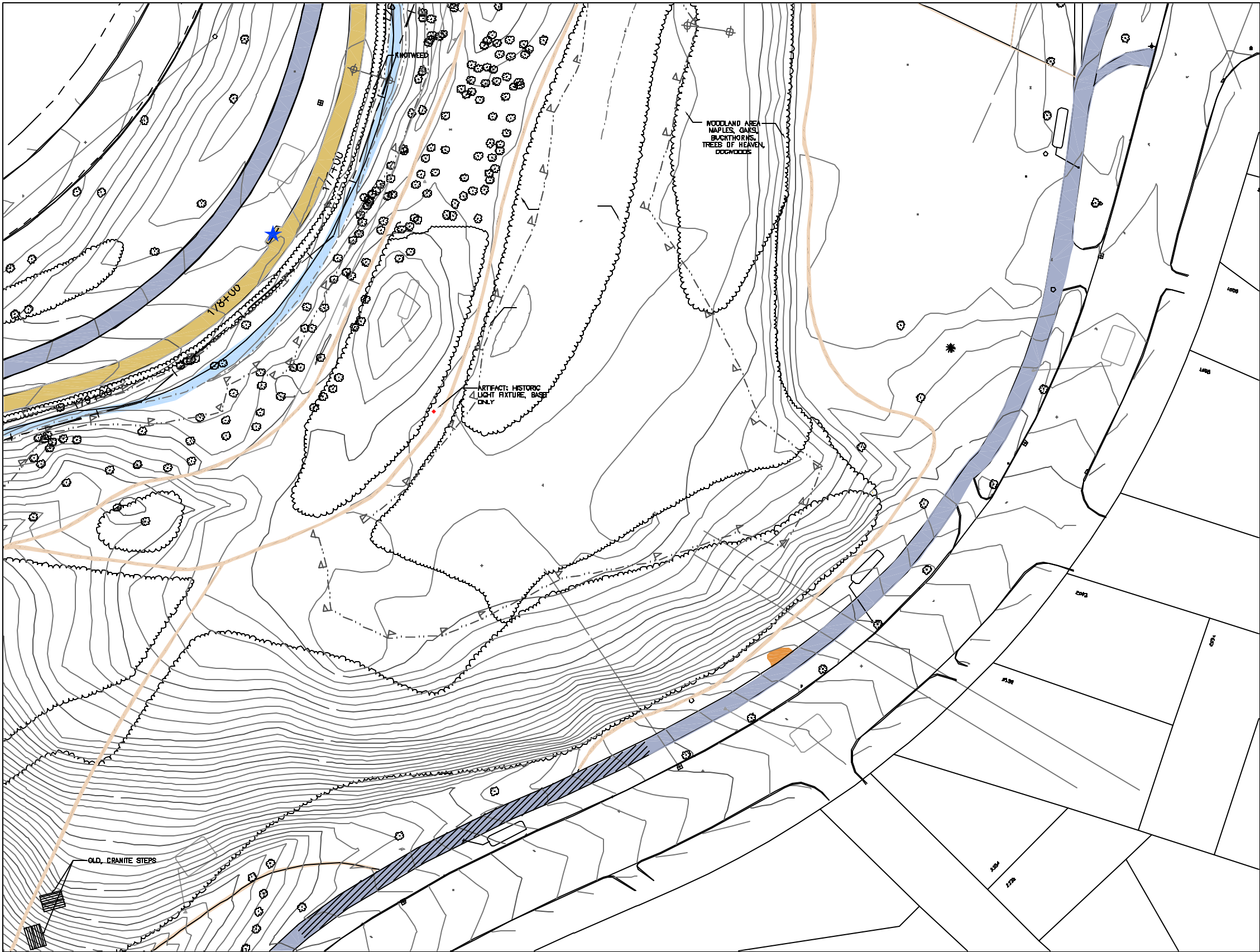


DRAWN BY: MC, LM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L45

MATCHLINE: SEE SHEET L47

MATCHLINE: SEE SHEET L45

MATCHLINE: SEE SHEET L44



MATCHLINE: SEE SHEET L48

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING

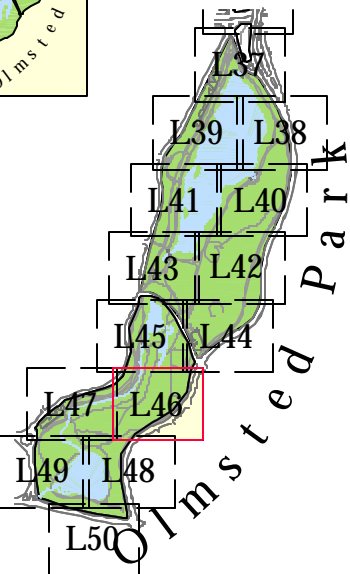
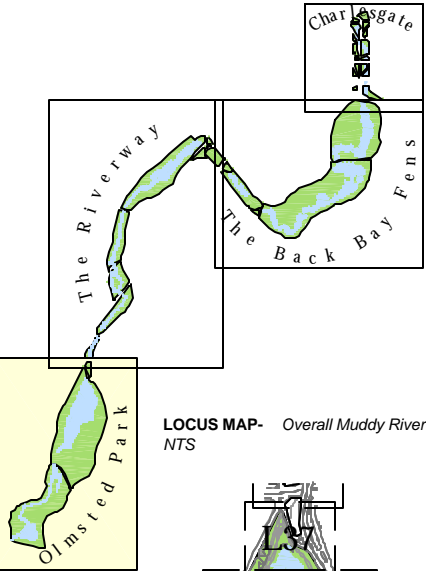
CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



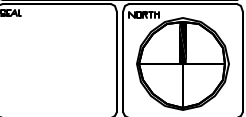
Pressley Associates, Inc.
425 Columbia Street
Cambridge, MA 02141
Phone: (617) 491-5300
FAX: (617) 491-7502
Email: pressley@pressleyinc.com

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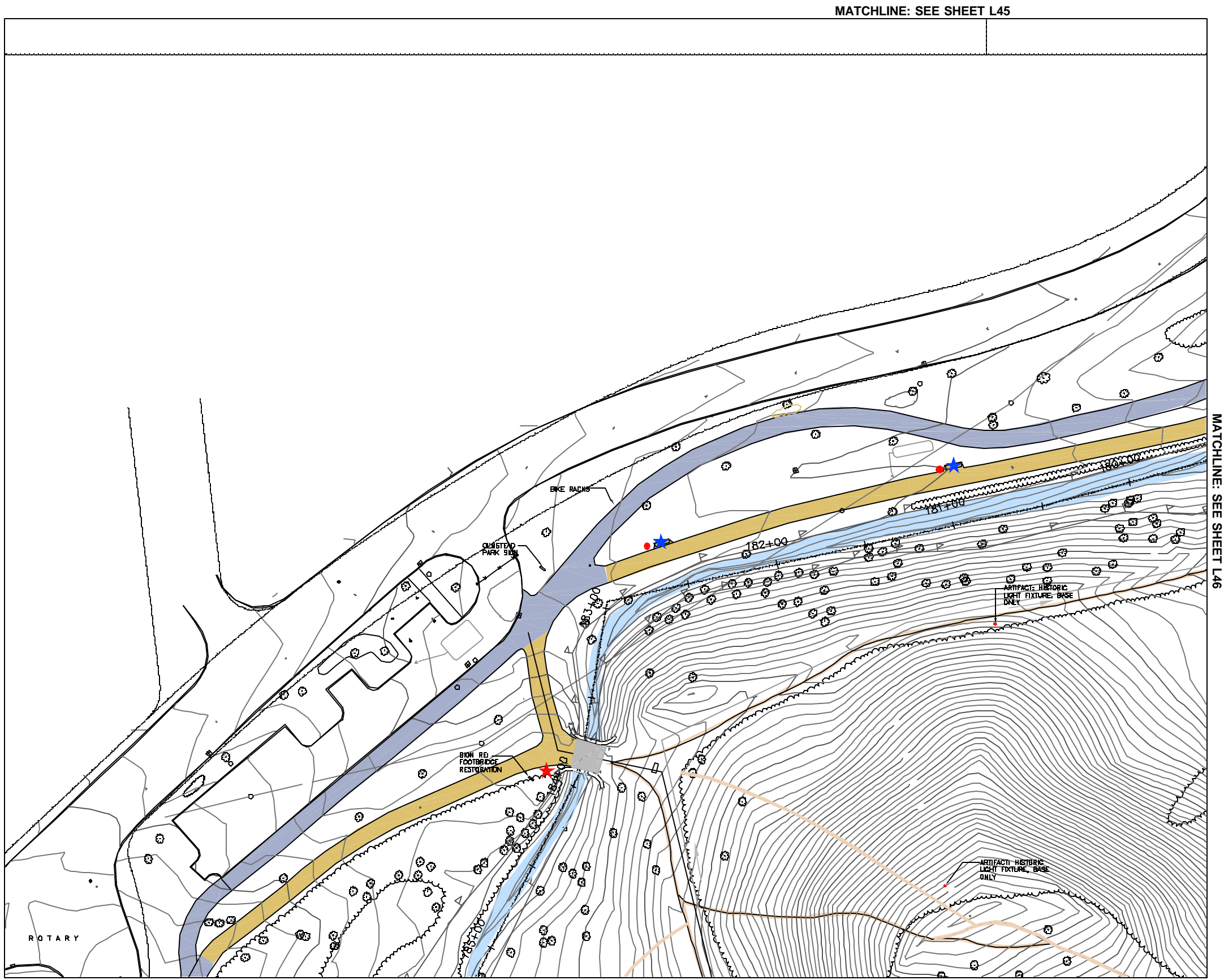
Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, MA
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L46



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING

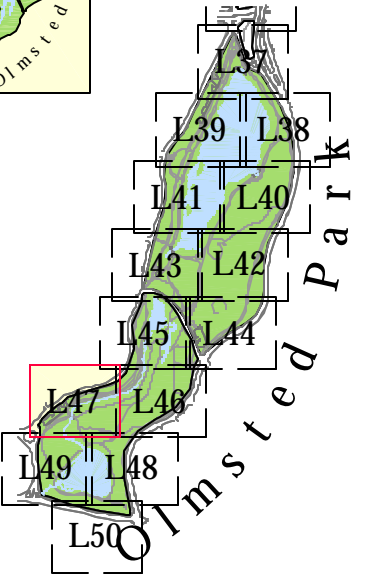
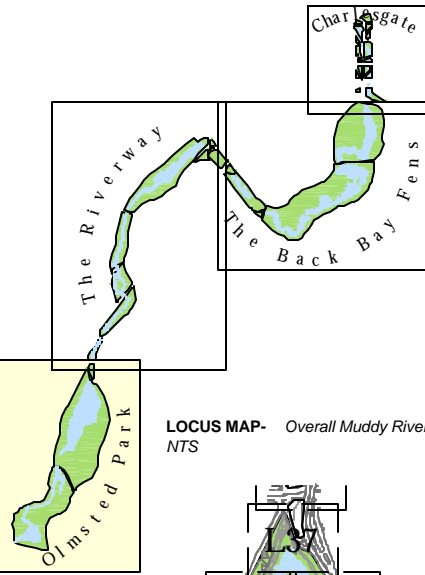
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BITUMINOUS CONCRETE SURFACE	[Pattern]	[Pattern]	[Pattern]
STONEDUST SURFACE	[Pattern]	[Pattern]	[Pattern]
BRICK SURFACE	[Pattern]	[Pattern]	[Pattern]
ROLLED STONE SURFACE	[Pattern]	[Pattern]	[Pattern]

DESIRE LINES [Symbol]

DEPRESSION ALONG PATHS [Symbol]

SITE FURNISHINGS

BENCH (NON-STANDARD)	[Red Star]
HISTORICAL BENCH STANDARD	[Blue Star]
MOBILE TRASH RECEPTACLE	[Red Dot]
STATIONARY TRASH RECEPTACLE	[Blue Dot]
HISTORICAL LIGHT FIXTURE	[Red Dot]



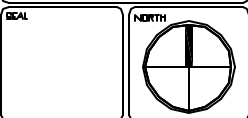
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Boston and Brookline, Massachusetts

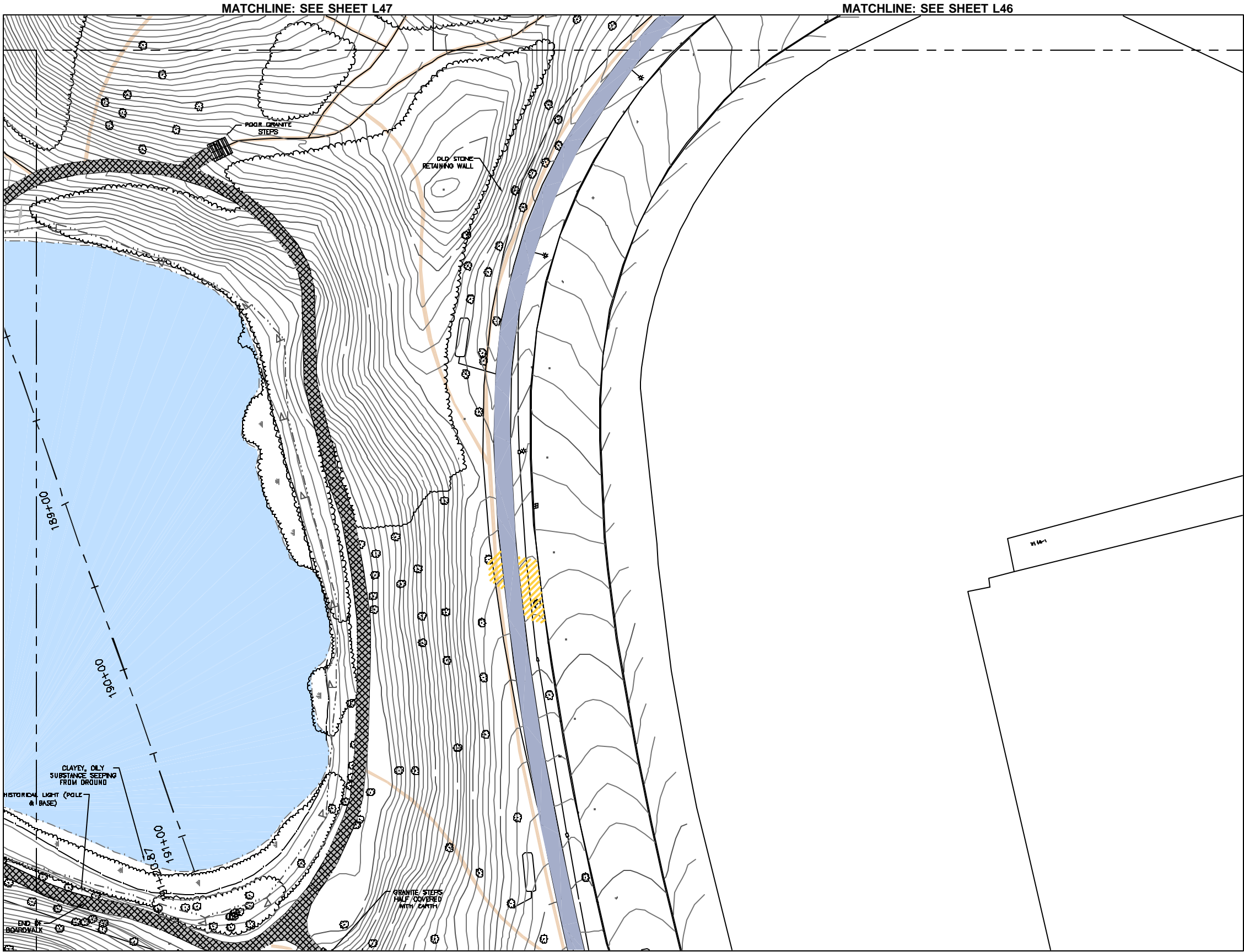
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DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: M.C. M4
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.: **L47**

MATCHLINE: SEE SHEET L49



MATCHLINE: SEE SHEET L50

LEGEND
INVENTORY AND ANALYSIS

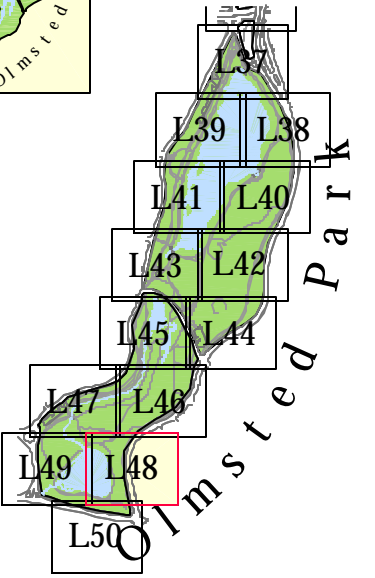
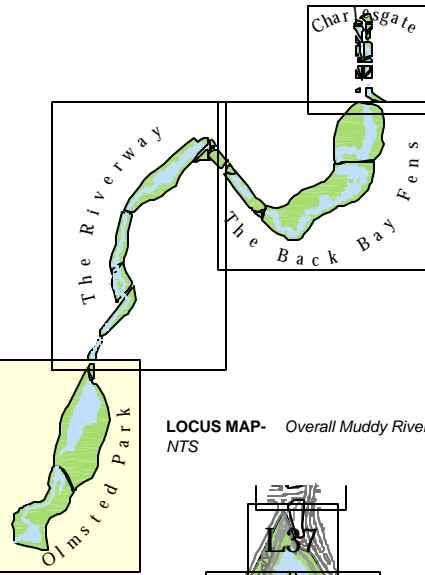
CIRCULATION/PAVING

CONCRETE SURFACE	
BITUMINOUS CONCRETE SURFACE	
STONEDUST SURFACE	
BRICK SURFACE	
ROLLED STONE SURFACE	

DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



LOCUS MAP - Olmsted Park NTS

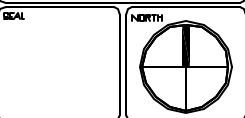
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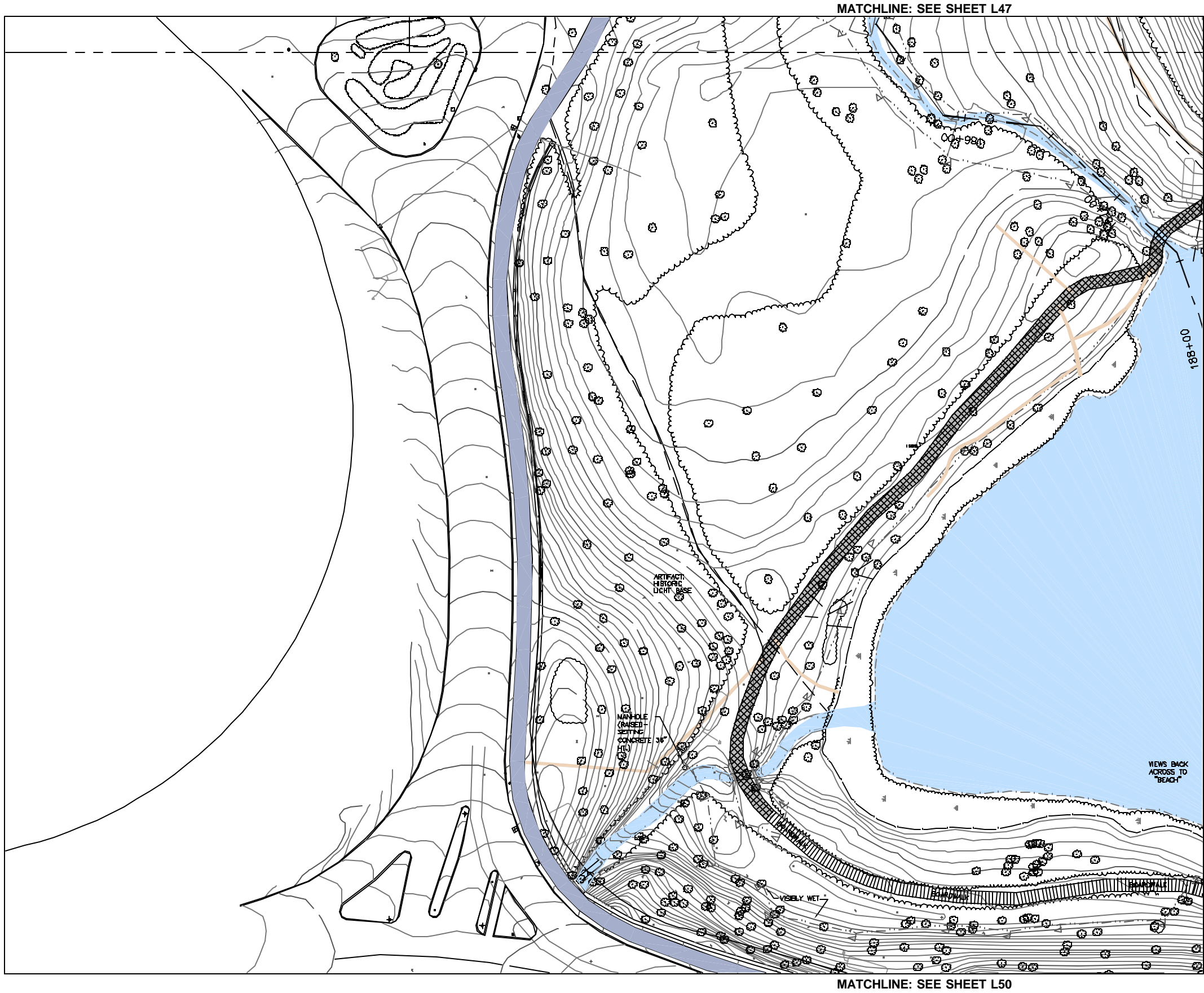
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DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, MN
CHECKED BY: MP
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SCALE: 1"=80'
DRAWING NO.: **L48**



MATCHLINE: SEE SHEET L47

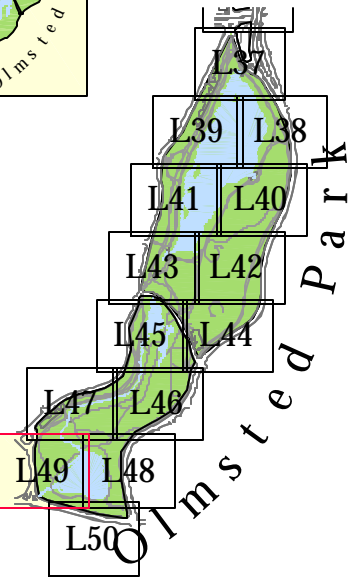
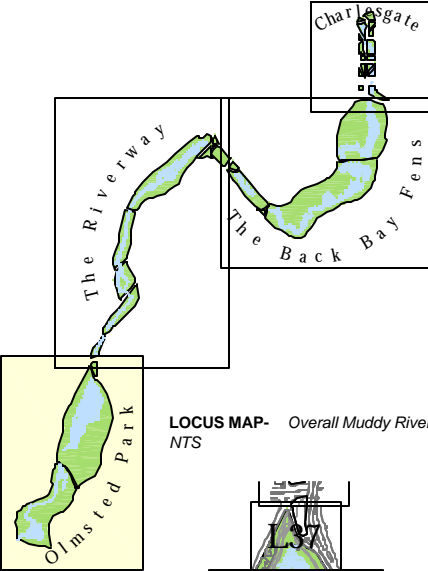
MATCHLINE: SEE SHEET L48

MATCHLINE: SEE SHEET L50

LEGEND
INVENTORY AND ANALYSIS

CIRCULATION/ PAVING
CONCRETE SURFACE
BITUMINOUS CONCRETE SURFACE
STONEDUST SURFACE
BRICK SURFACE
ROLLED STONE SURFACE
DESIRE LINES
DEPRESSION ALONG PATHS

SITE FURNISHINGS
BENCH (NON-STANDARD)
HISTORICAL BENCH STANDARD
MOBILE TRASH RECEPTACLE
STATIONARY TRASH RECEPTACLE
HISTORICAL LIGHT FIXTURE



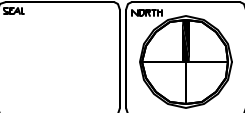
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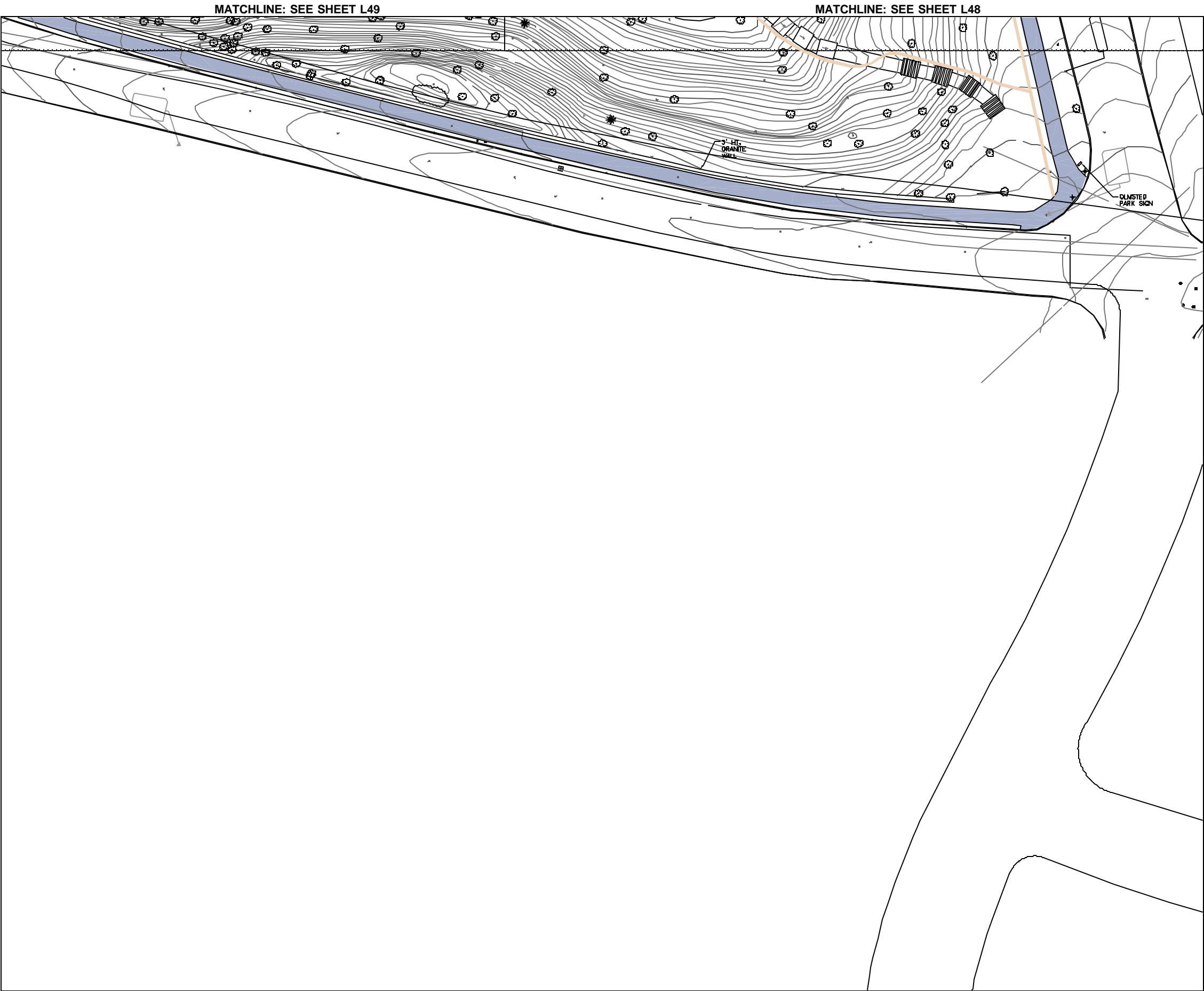
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DRAWING TITLE
Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, LM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=30'
DRAWING NO.
L49



LEGEND
INVENTORY AND ANALYSIS

CIRCULATION / PAVING

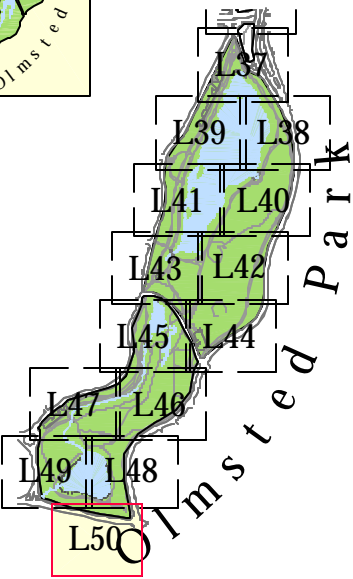
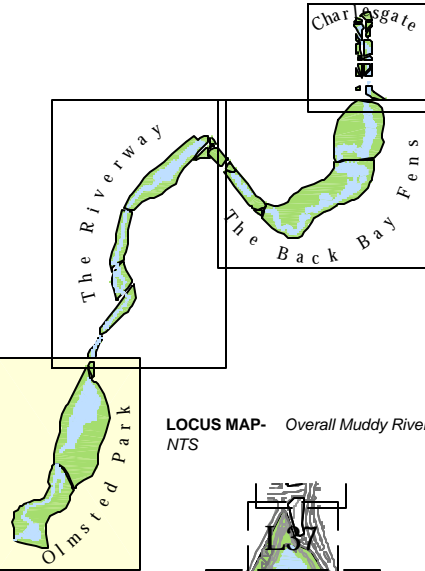
CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			

DESIRE LINES

DEPRESSION ALONG PATHS

SITE FURNISHINGS

BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



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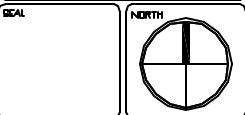
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DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING



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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

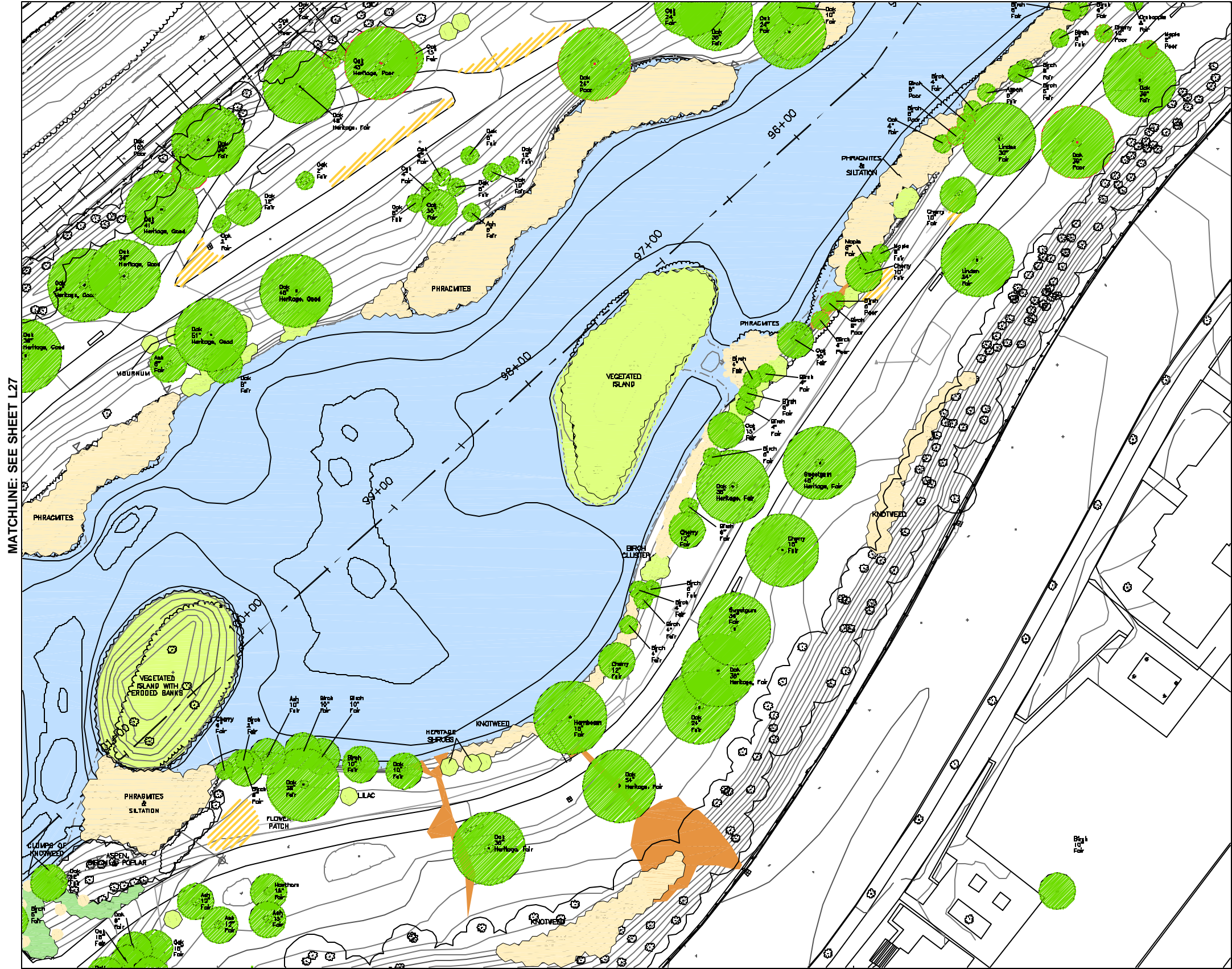
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L50

**Appendix G: MUDDY RIVER RESTORATION PROJECT
INVENTORY AND ANALYSIS MAPS
– VEGETATION & EROSION**

MATCHLINE: SEE SHEET L25

MATCHLINE: SEE SHEET L27



MATCHLINE: SEE SHEET L28

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

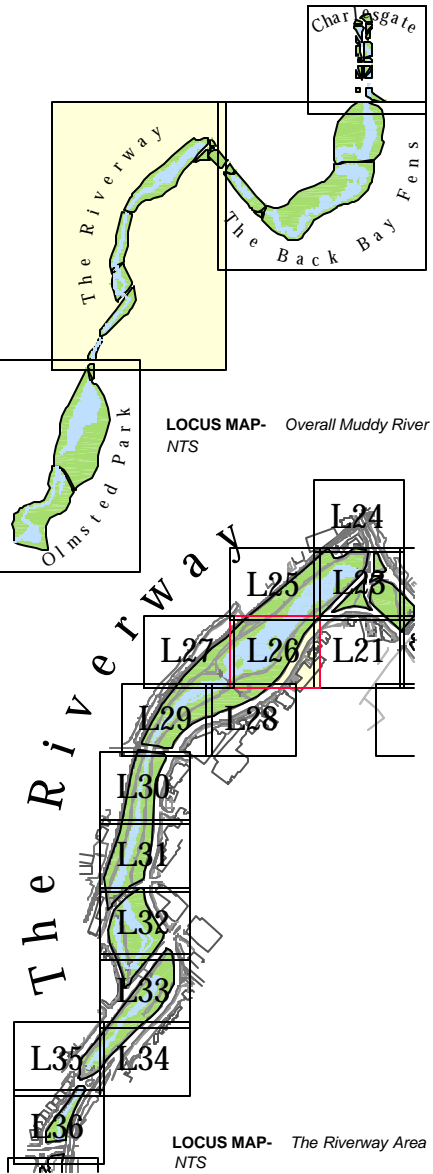
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



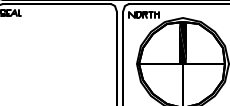
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REVISION	NO.	DATE	REMARKS
A	3/1/01		

DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION



DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=50'

DRAWING NO.
L26



MATCHLINE: SEE SHEET L29

MATCHLINE: SEE SHEET L28

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA

Symbol for Deciduous Tree

Symbol for Evergreen Tree

Symbol for Tree Mass

Symbol for Mass of Restored Planting

Symbol for Mass of Shrubs

Symbol for Invasive Plant Colony

Symbol for Bare Lawn

Symbol for Erosion Area

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

Graphic Scale: 0 to 40 feet

North Arrow

REVISIONS

NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION

DRAWN BY: MC, MM

CHECKED BY: MP

DATE: 11/21/00

SCALE: 1"=60'

DRAWING NO.

L27

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MATCHLINE: SEE SHEET L26




















The Muddy River Restoration Project






Boston and Brookline, Massachusetts

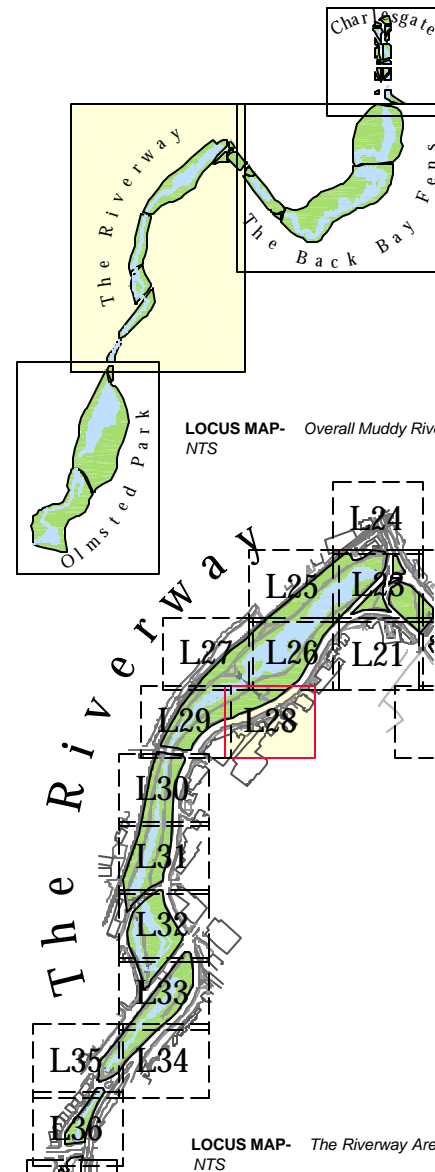
<h2>LEGEND</h2> <h3>INVENTORY AND ANALYSIS</h3>

<h4>CIRCULATION/PAVING</h4>

CONCRETE SURFACE			
BITUMINOUS CONCRETE SURFACE			
STONEDUST SURFACE			
BRICK SURFACE			
ROLLED STONE SURFACE			
DESIRE LINES			
DEPRESSION ALONG PATHS			

<h4>SITE FURNISHINGS</h4>

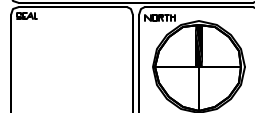
BENCH (NON-STANDARD)	
HISTORICAL BENCH STANDARD	
MOBILE TRASH RECEPTACLE	
STATIONARY TRASH RECEPTACLE	
HISTORICAL LIGHT FIXTURE	



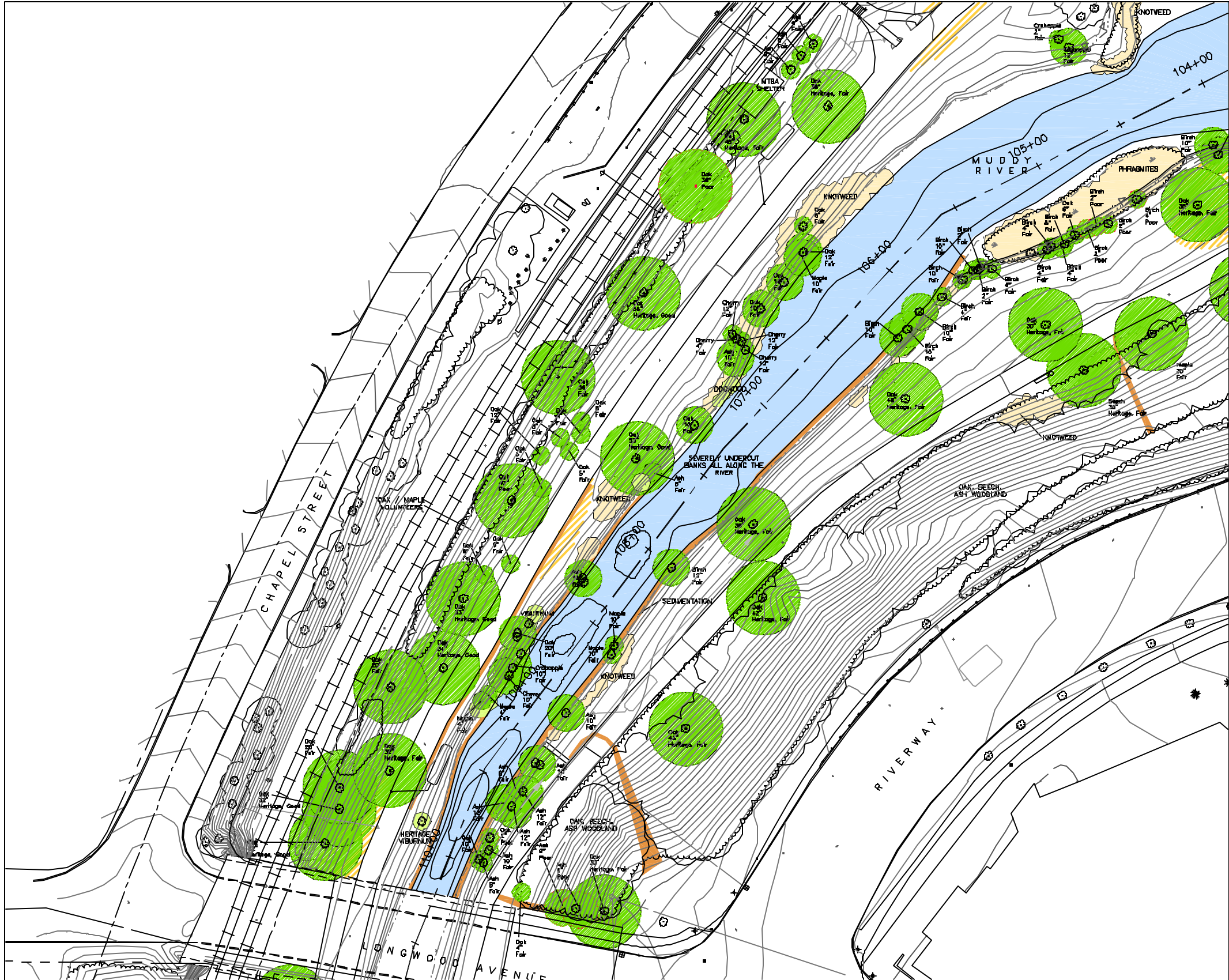
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A	3/1/01	

DRAWING TITLE

Inventory and Analysis
CIRCULATION /
SITE FURNISHING



DRAWN BY: MC, MM	DRAWING NO.
CHECKED BY: MP	L28
DATE: 11/21/00	
SCALE: 1"=60'	



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA

LOCUS MAP- Overall Muddy River NTS

LOCUS MAP- The Riverway Area NTS

REVISIONS

NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE

0 20 40

SCALE

1"=60'

DRAWN BY MC, MM
CHECKED BY MP
DATE 11/21/00
SCALE 1"=60'

DRAWING NO.

L29

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DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE

0 20 40

SCALE

1"=60'

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DATE 11/21/00
SCALE 1"=60'

DRAWING NO.

L29

This is a detailed landscape architectural plan for a riverway area. The plan shows the Muddy River flowing through the center, with a riverway on the right and a road on the left. Numerous trees are planted along the riverbanks, with labels for species like VIBURNUM, KNOTWEED, and ALDER. The plan also includes a 'FLOWER PATCH' and 'ROSES' area. The river is labeled 'MUDDY RIVER' and the road is labeled 'ROAD'. The plan includes a north arrow and a scale bar.

MATCHLINE: SEE SHEET L32

Wuddy River Restoration Project

Boston and Brookline, Massachusetts


The Muddy River Restoration Project


Boston and Brookline, Massachusetts


LEGEND
INVENTORY AND ANALYSIS

VEGETATION


TREES


DECIDUOUS TREE  Spanish
Oak
Catalpa


EVERGREEN TREE  Bay
Lemon
Dwarf Olive

TREE MASS 


SHRUBS


MASS OF RESTORED PLANTING 

MASS OF SHRUBS 

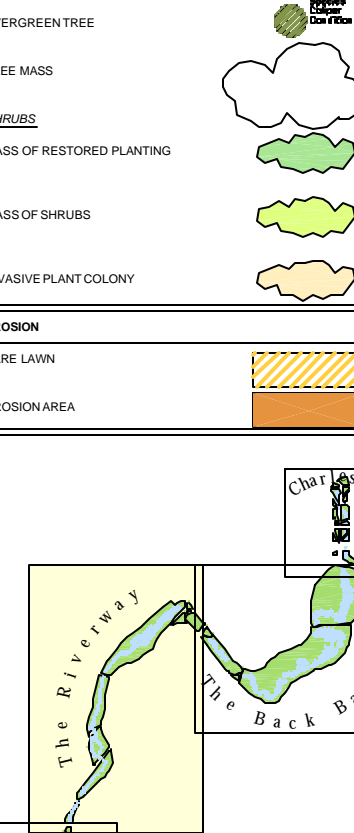
INVASIVE PLANT COLONY 

EROSION

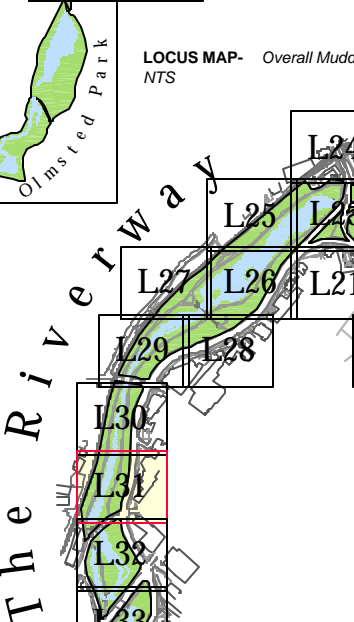
BARE LAWN 

EROSION AREA 

LOCUS MAP- Overall Muddy River NTS

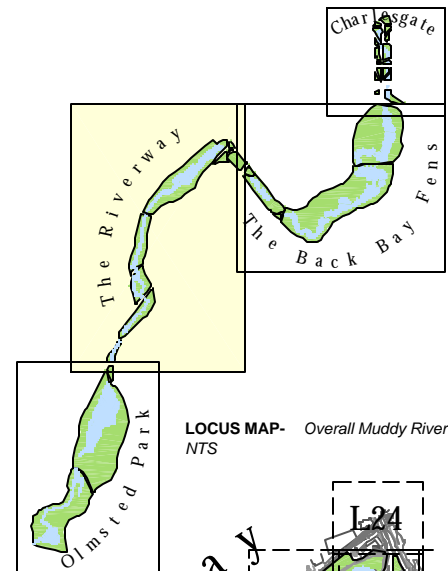


LOCUS MAP- The Riverway Area NTS



MATCHLINE: SEE SHEET L33

EROSION AREA



LOCUS MAP- Overall Muddy River
NTS

The Riverway

L24
L25
L26
L27
L28
L29
L30
L31
L32
L33
L34
L35
L36

LOCUS MAP- The Riverway Area
NTS


LOCUS MAP- *The Riverway Area*
NTS

[illegible]

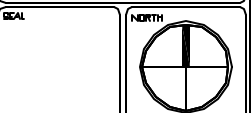
DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE



A horizontal scale bar with alternating black and white segments. It is marked with '20' at the left end, '0' in the middle, '20' at the right end, and '40' at the far right end.



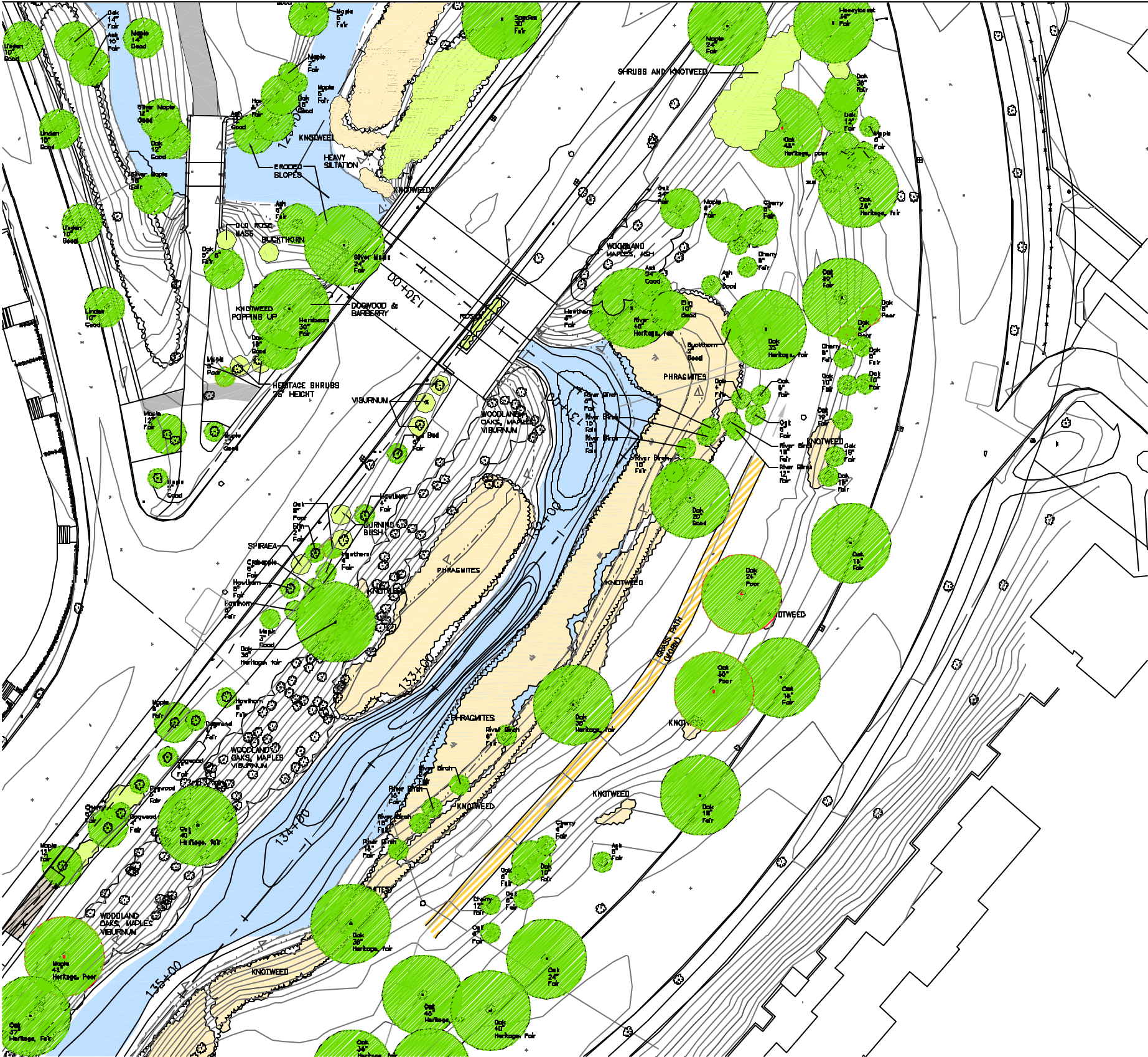
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DATE: 11/21/00	
SCALE: 1"=60'	

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MATCHLINE: SEE SHEET L32



MATCHLINE: SEE SHEET L34

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

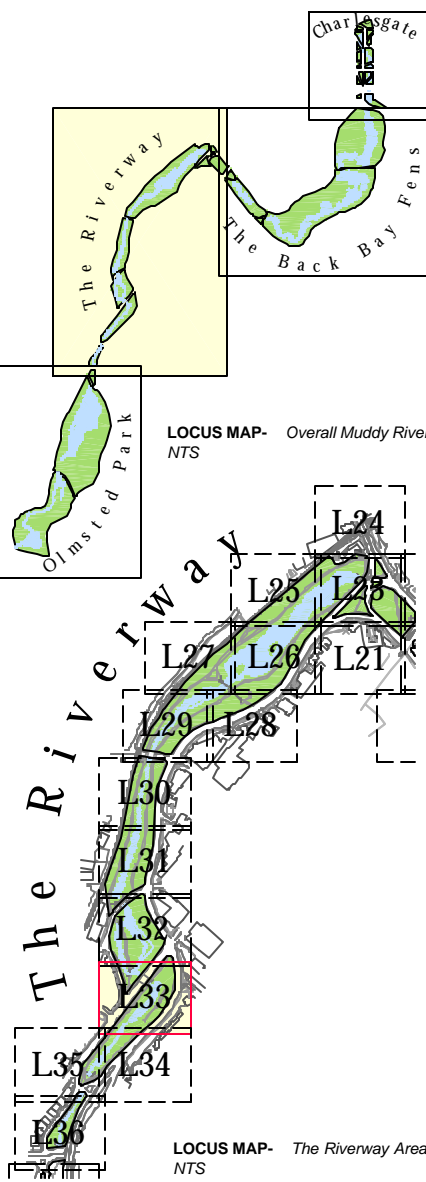
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



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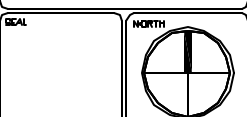
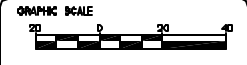
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VEGETATION /
EROSION



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SCALE: 1"=80'

DRAWING NO.
L33

WOODLAND THICK, STEEP, FENCED OFF, WESTLY OAK, MAPLE, ALANTHUS, KNOTWEED

RIVER STREET

RIVERWAY

WASHINGTON STREET



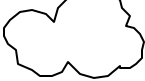





HUNTINGTON AVENUE

Oak 40
Maple 12
Oak 10

WOODLAND THICK, STEEP, FENCED OFF, WESTLY OAK, MAPLE, ALANTHUS, KNOTWEED

146+00

147+00

LEGEND	
INVENTORY AND ANALYSIS	
VEGETATION	
<u>TREES</u>	
DECIDUOUS TREE	 Species Canopy Composition
EVERGREEN TREE	 Species Canopy Composition
TREE MASS	
<u>SHRUBS</u>	
MASS OF RESTORED PLANTING	
MASS OF SHRUBS	
INVASIVE PLANT COLONY	
EROSION	
BARE LAWN	
EROSION AREA	

The Riverway

L24

L25

L26

L27

L28

L29

L30

L31

L32

L33

L34

L35

L36

LOCUS MAP- The Riverway Area
NTS

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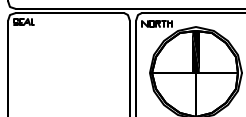
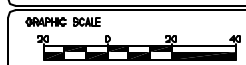
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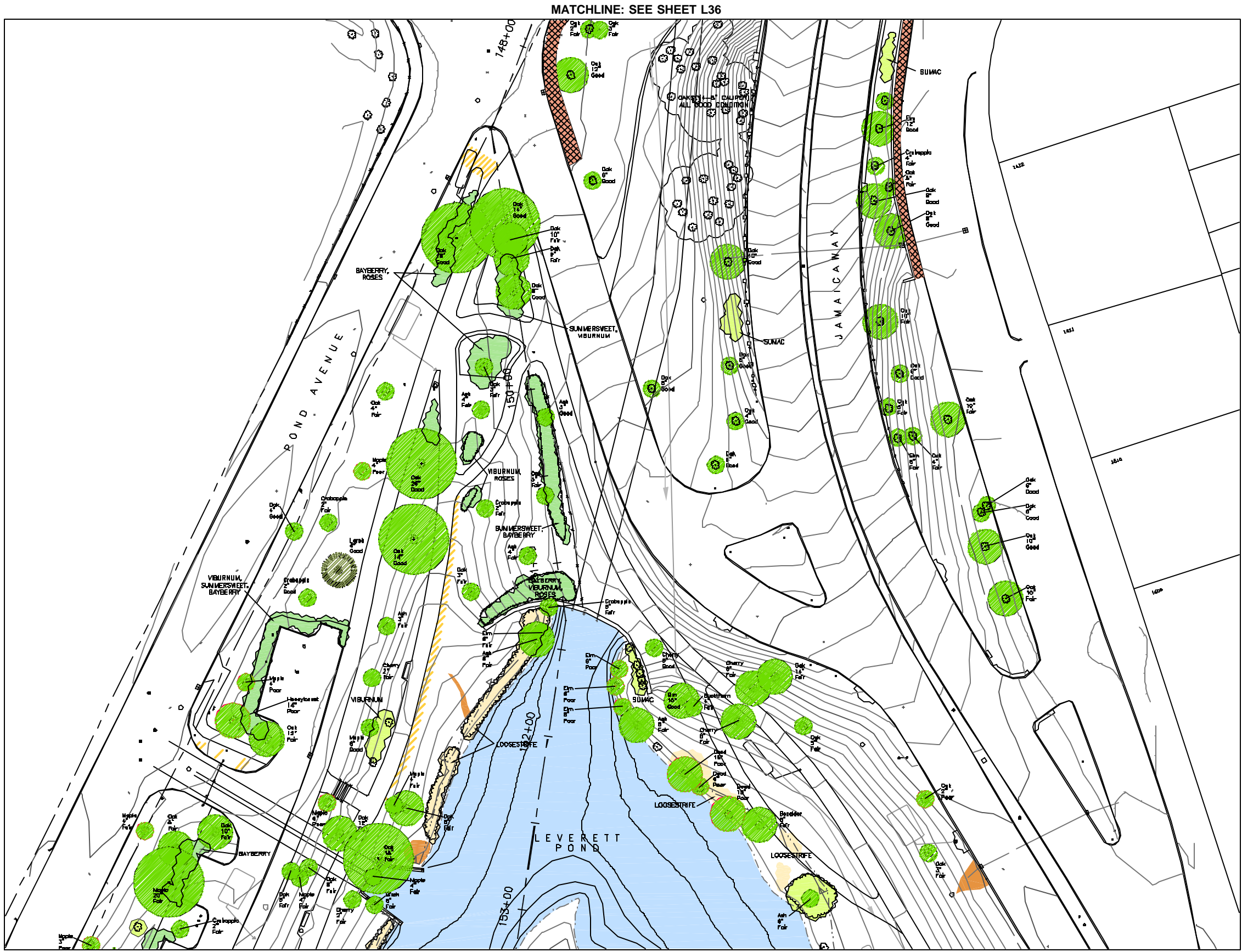
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DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION



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CHECKED BY: MP	L36
DATE: 11/21/00	
SCALE: 1"=60'	



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

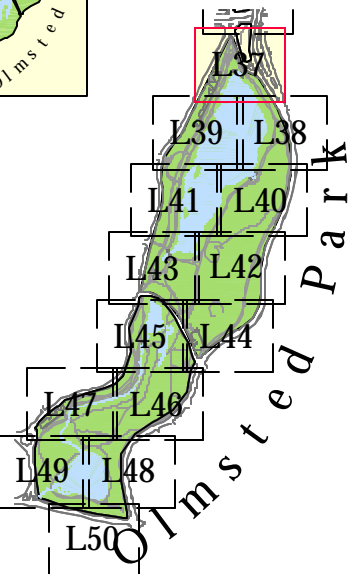
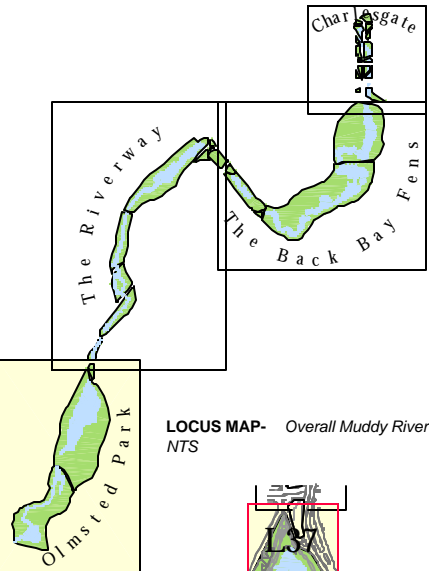
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



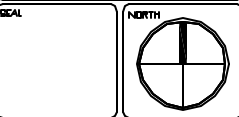
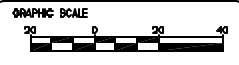
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VEGETATION /
EROSION



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DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.
L37

MATCHLINE: SEE SHEET L39



MATCHLINE: SEE SHEET L40

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

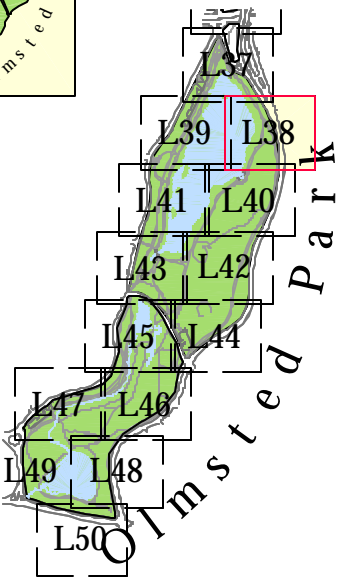
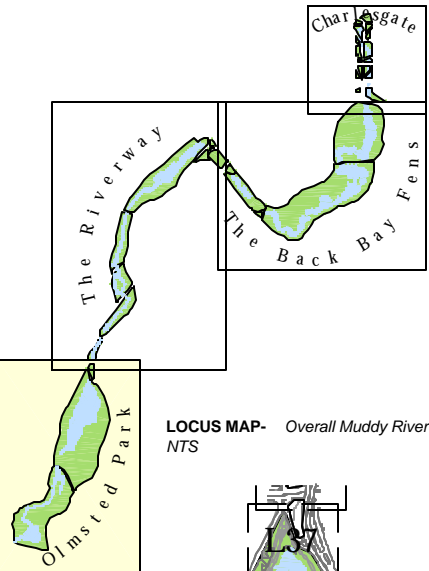
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



LOCUS MAP - Olmsted Park NTS

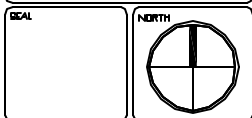
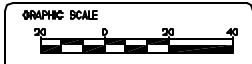
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NO.	DATE	REMARKS
A	3/1/01	

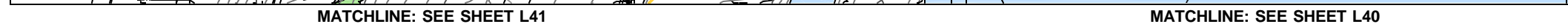
DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION



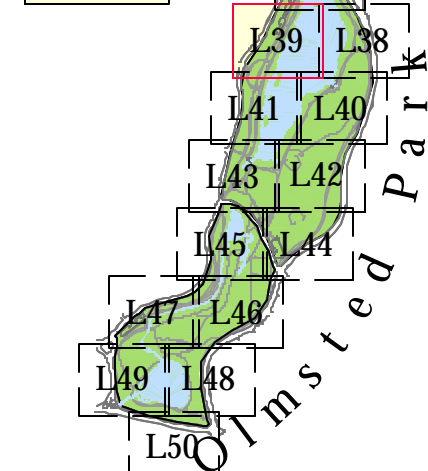
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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
L38

MATCHLINE: SEE SHEET L40

MATCHLINE: SEE SHEET L41

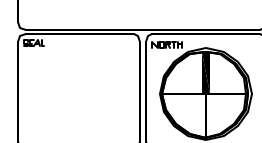


A map of the Riverway and The Back Bay area in New York City. The Riverway is shown as a green and blue area, and The Back Bay is shown as a green area. The Charlestown area is highlighted in red and labeled 'Charlestown'.



DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION



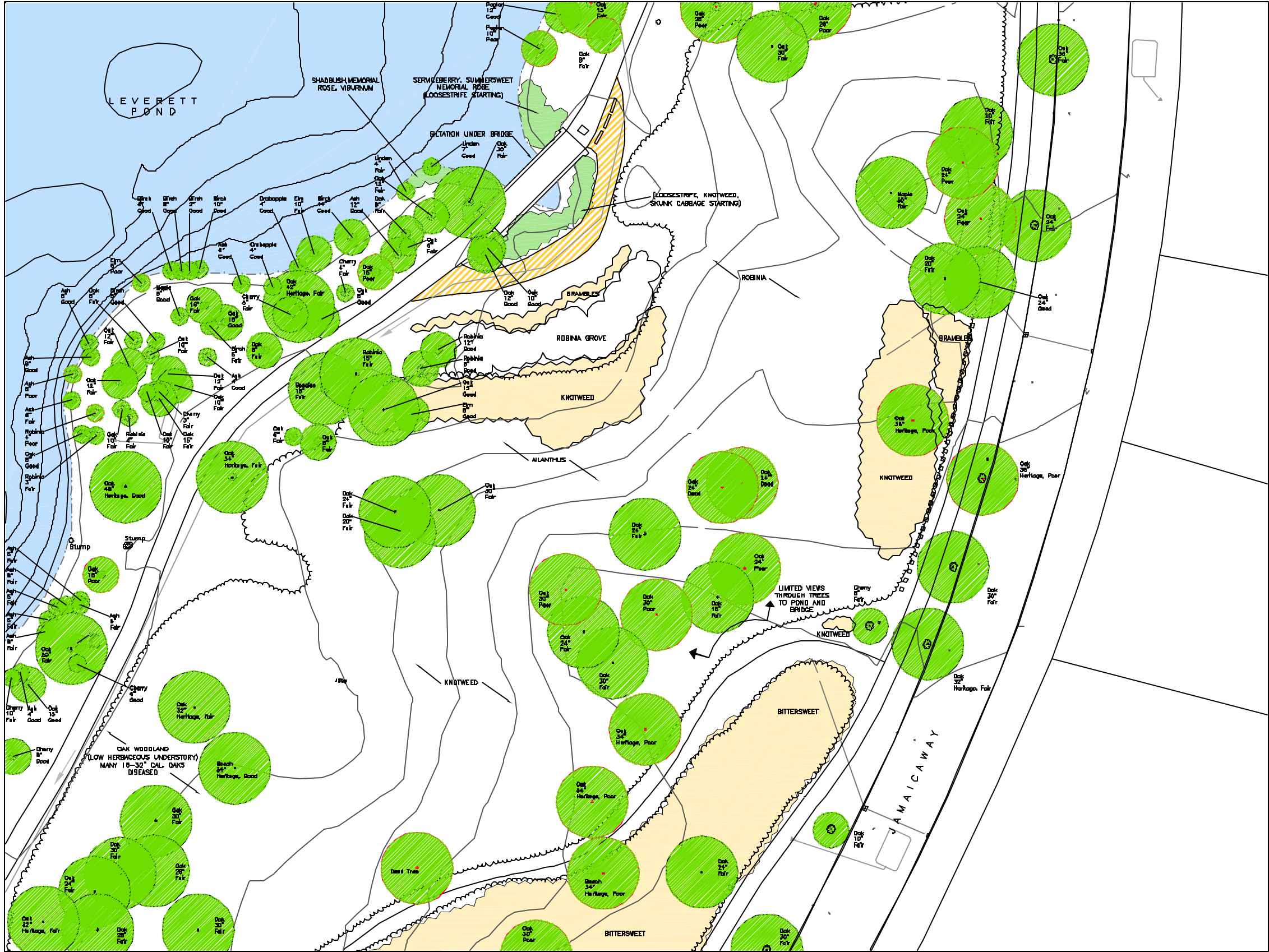
DRAWN BY: MC, MM CHECKED BY: MP DATE: 11/21/00 SCALE: 1"=60"	DRAWING NO. L39
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MATCHLINE: SEE SHEET L38

MATCHLINE: SEE SHEET L41

MATCHLINE: SEE SHEET L42



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

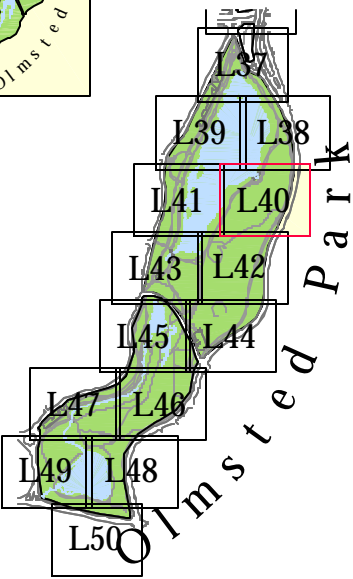
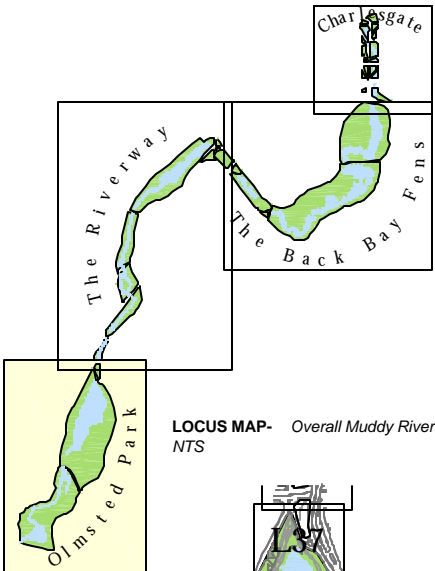
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



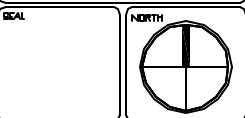
Pressley Associates, Inc.
425 Columbia Street
Cambridge, MA 02141
Phone: (617) 491-5300
FAX: (617) 491-7502
Email: pressley@pressleyinc.com

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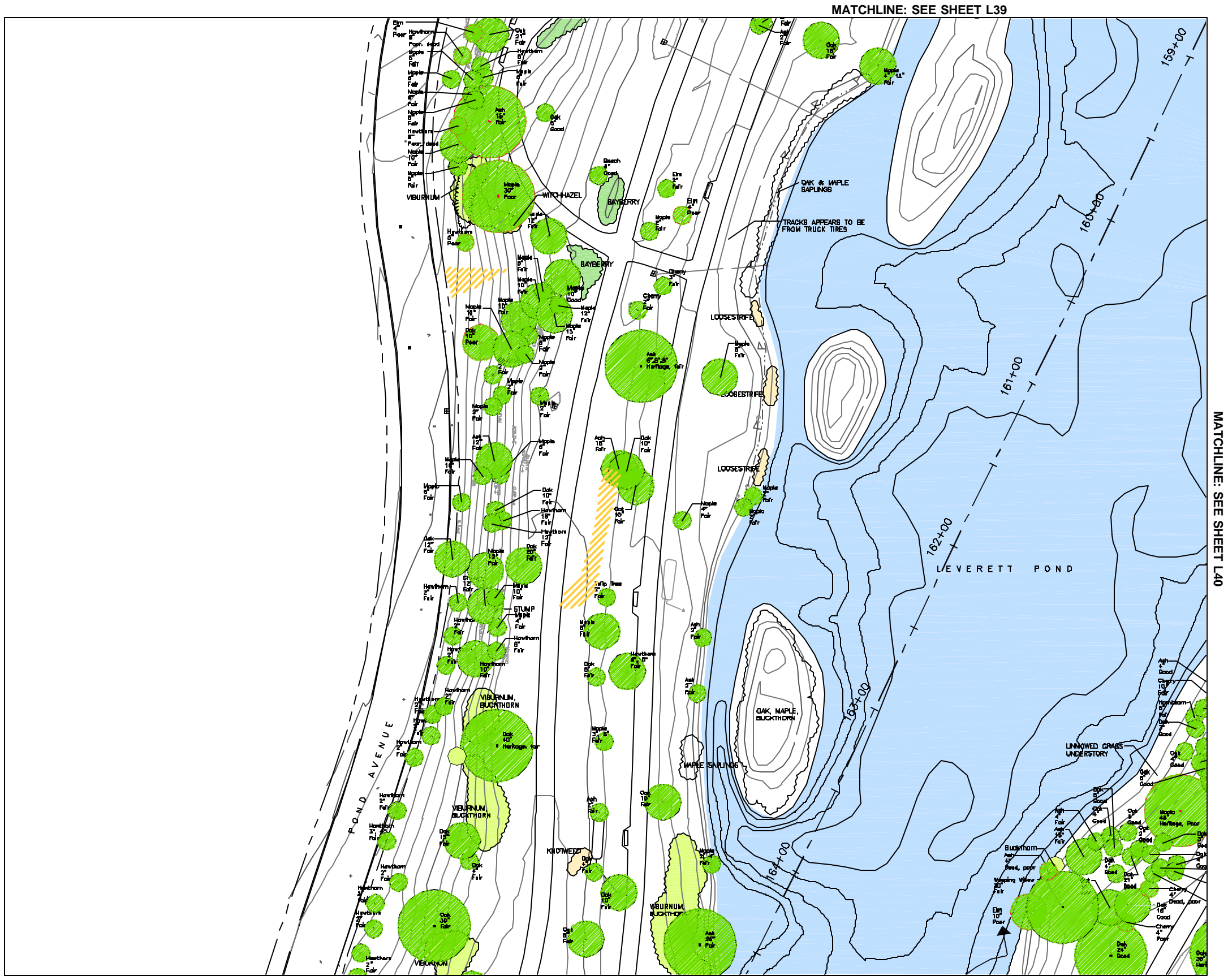
Boston and Brookline, Massachusetts

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NO.	DATE	REMARKS
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DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION



DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
DRAWING NO.
L40



MATCHLINE: SEE SHEET L43

MATCHLINE: SEE SHEET L42

MATCHLINE: SEE SHEET L40

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

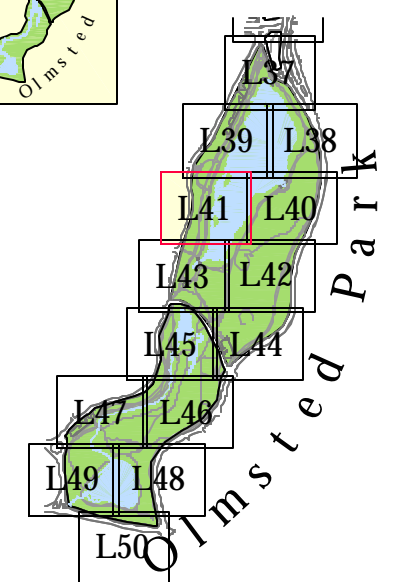
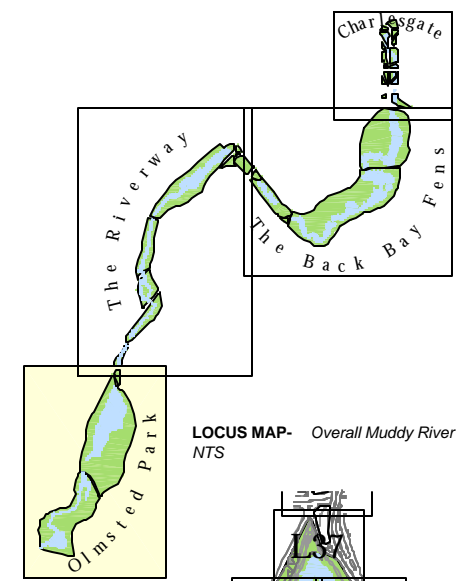
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



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DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE
0 20 40

DRAWN BY: M.C. MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

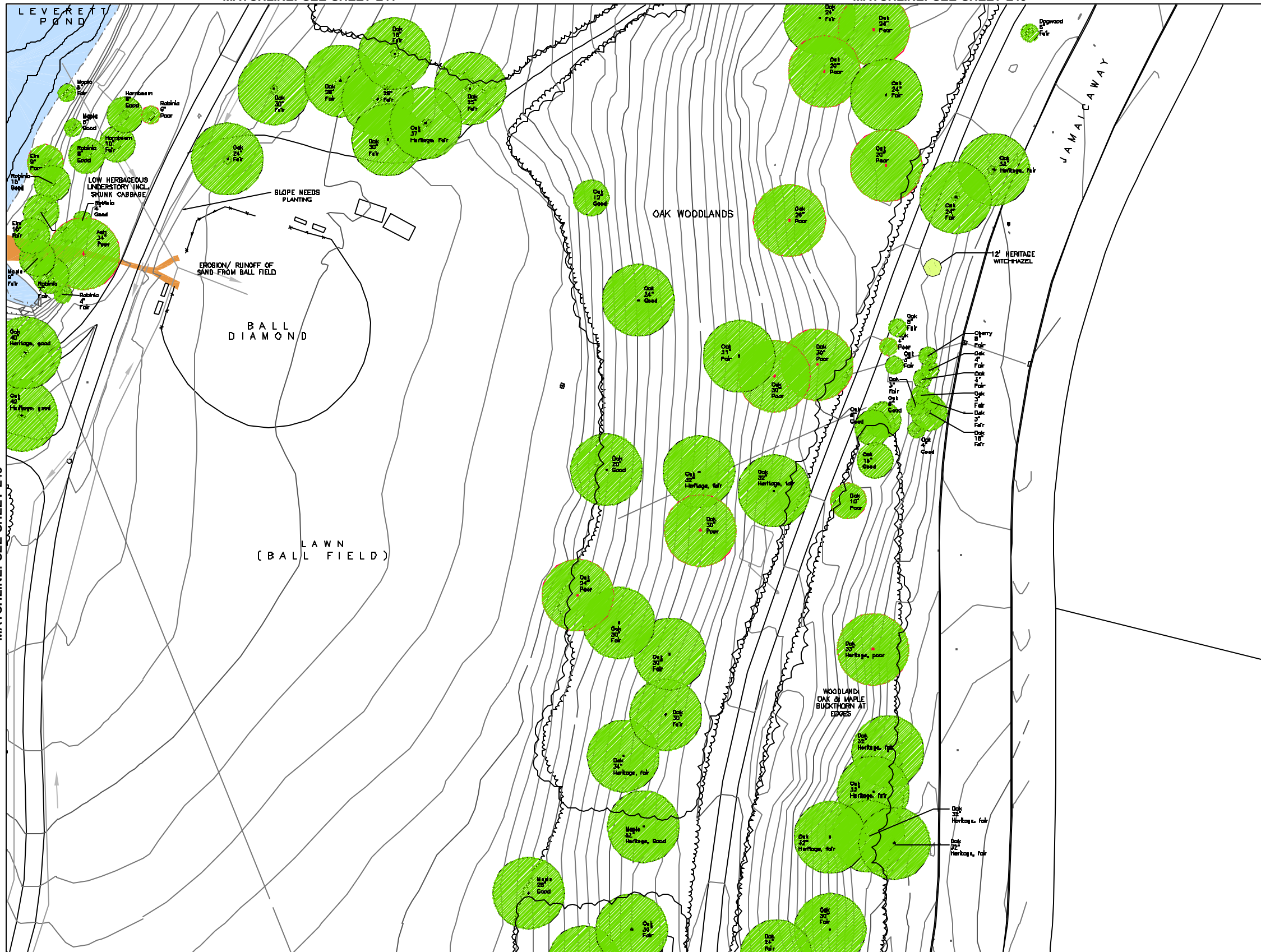
DRAWING NO.

L41

MATCHLINE: SEE SHEET L43

MATCHLINE: SEE SHEET L41

MATCHLINE: SEE SHEET L40



MATCHLINE: SEE SHEET L44

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TRESS

DECIDUOUS TRE

EVERGREEN TR

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

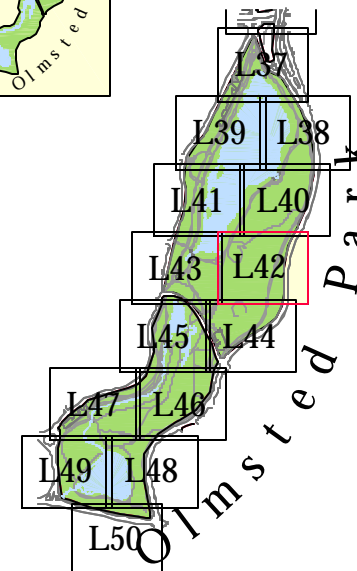
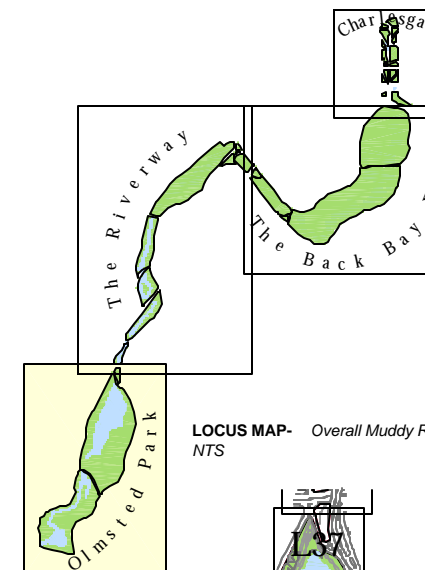
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



LOCUS MAP- *Olmsted Park*
NTS

REVISIONS		
NO.	DATE	REMARKS
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DRAWING TITLE

Inventory and Analysis
VEGETATION /
EROSION

GRAPHIC SCALE



DEAR

NORT



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DATE: 11/21/00

SCALE: 1"=60'

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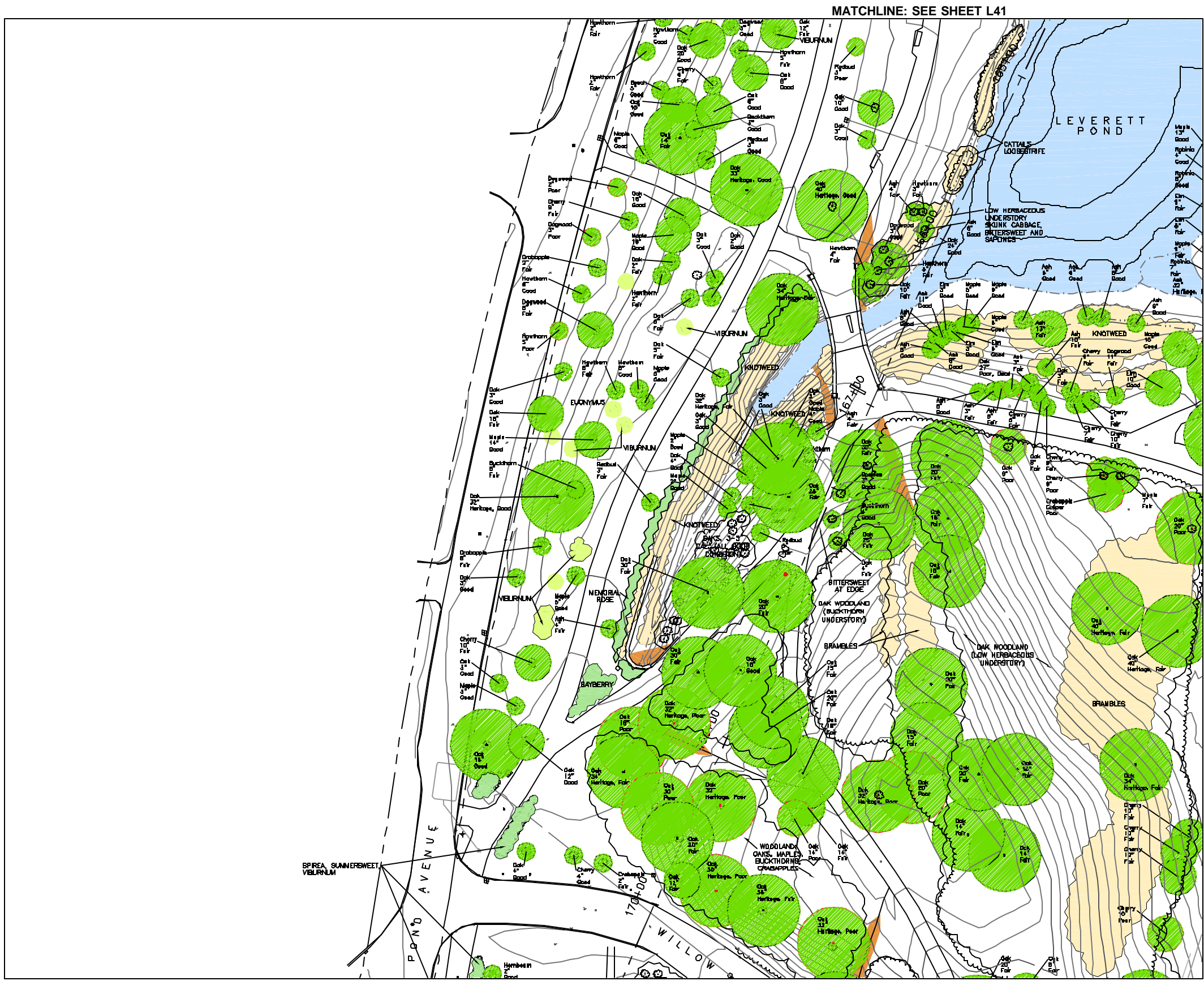
LI

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L42



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

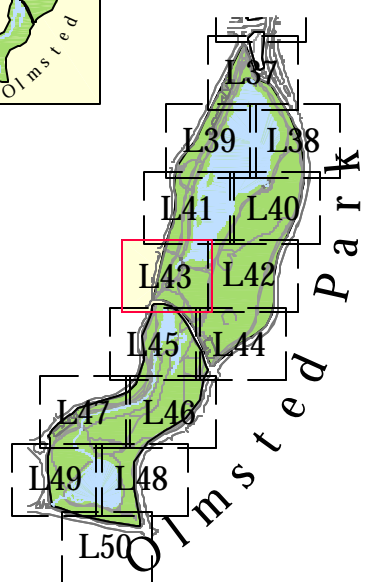
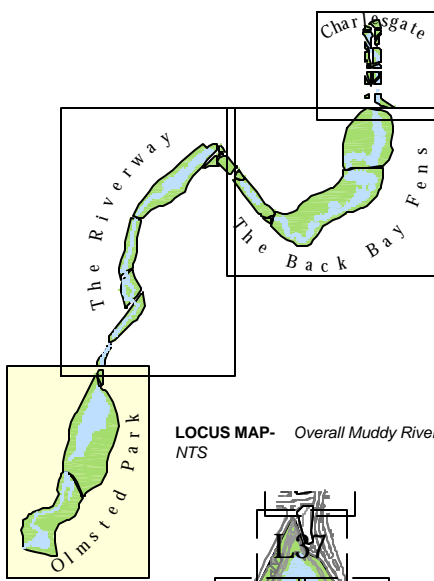
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



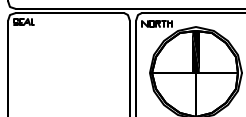
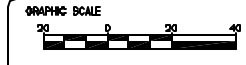
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Boston and Brookline, Massachusetts

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NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION

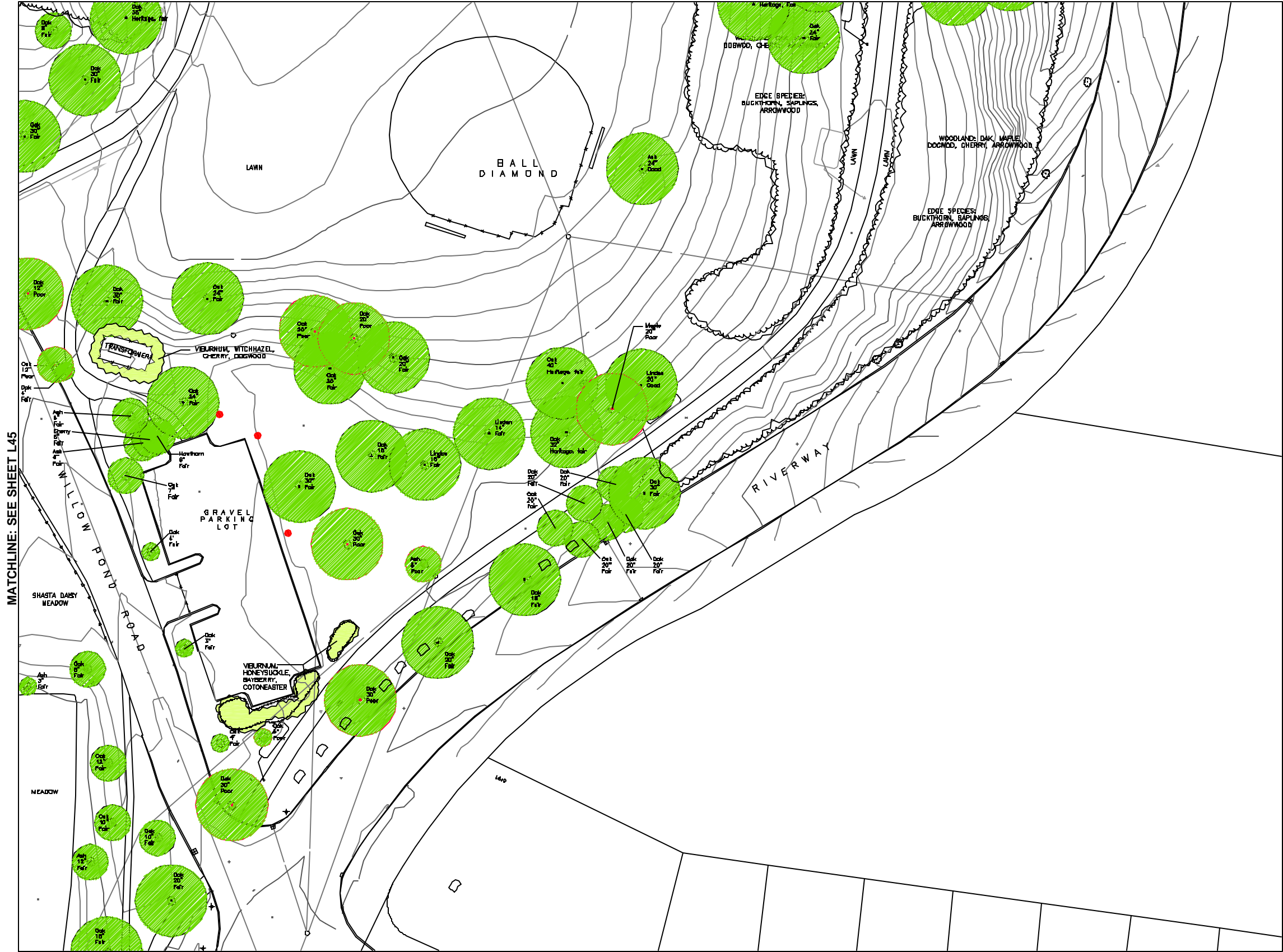


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SCALE: 1"=80'

DRAWING NO.
L43

MATCHLINE: SEE SHEET L43

MATCHLINE: SEE SHEET L42



MATCHLINE: SEE SHEET L46

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

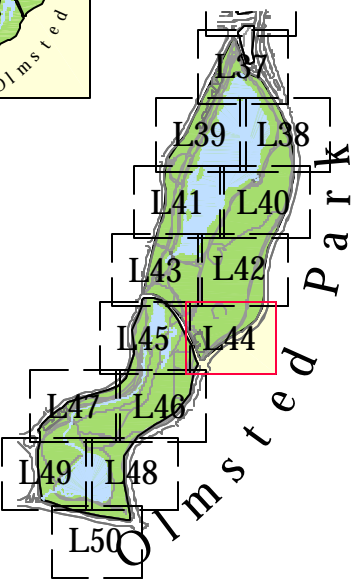
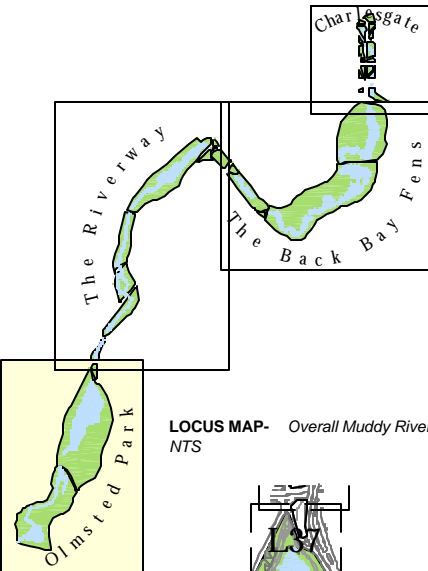
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



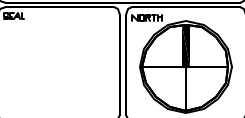
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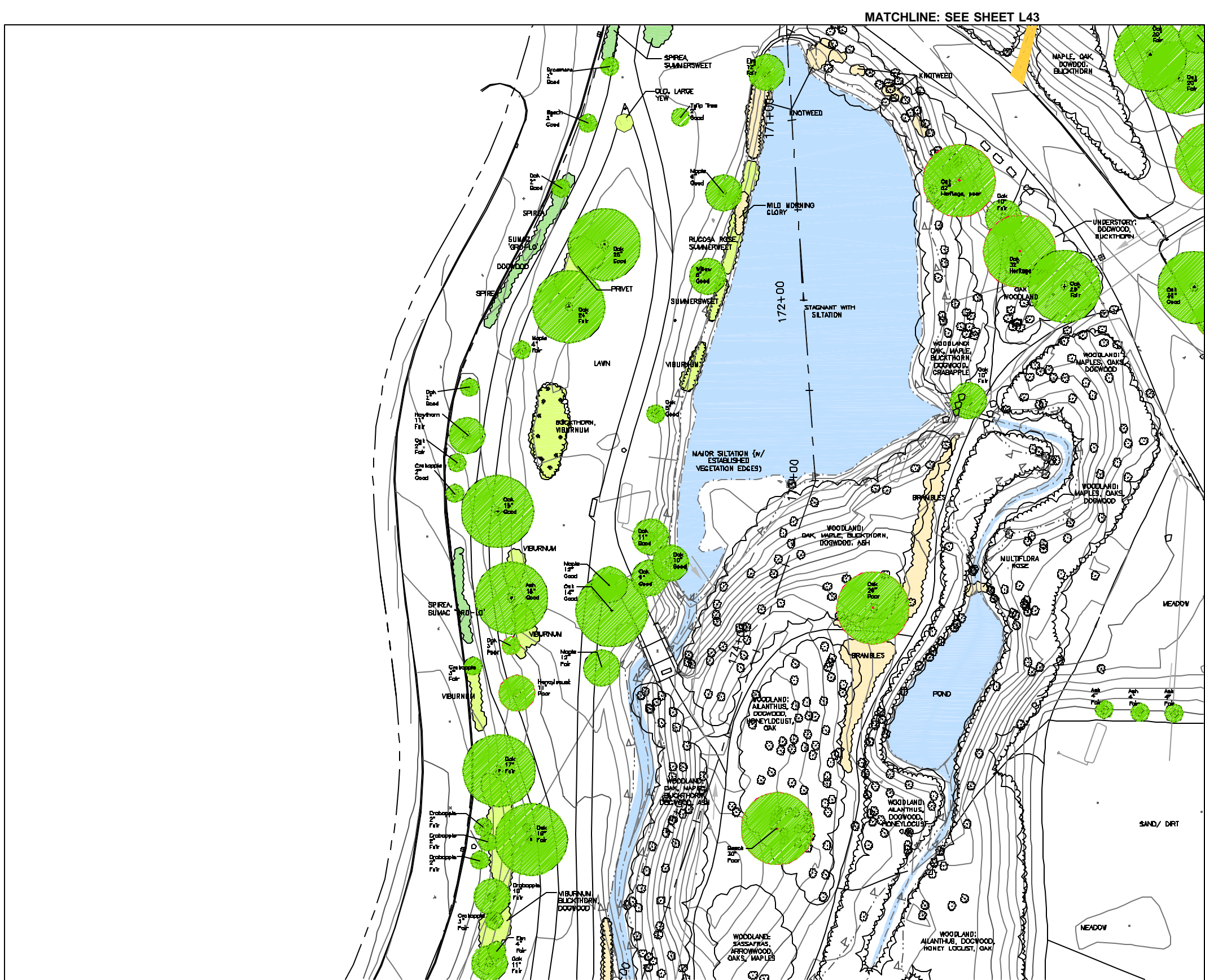
NO.	DATE	REVISIONS
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DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION

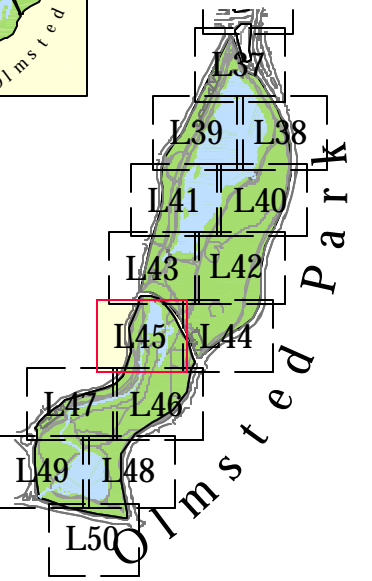
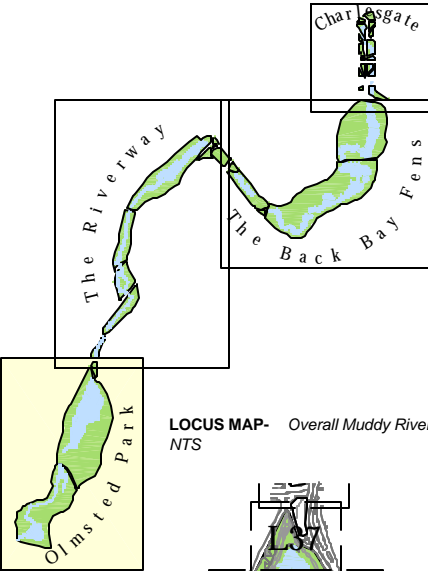


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CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'

DRAWING NO.
L44



LEGEND	
INVENTORY AND ANALYSIS	
VEGETATION	
TREES	
DECIDUOUS TREE	Spirea, Dogwood
EVERGREEN TREE	Spruce, Fir, Redwood
TREE MASS	Tree Mass
SHRUBS	
MASS OF RESTORED PLANTING	Mass of Restored Planting
MASS OF SHRUBS	Mass of Shrubs
INVASIVE PLANT COLONY	Invasive Plant Colony
EROSION	
BARE LAWN	Bare Lawn
EROSION AREA	Erosion Area



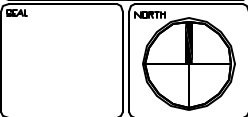
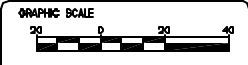
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FAX: (617) 491-7502
Email: pressley@pressleyinc.com

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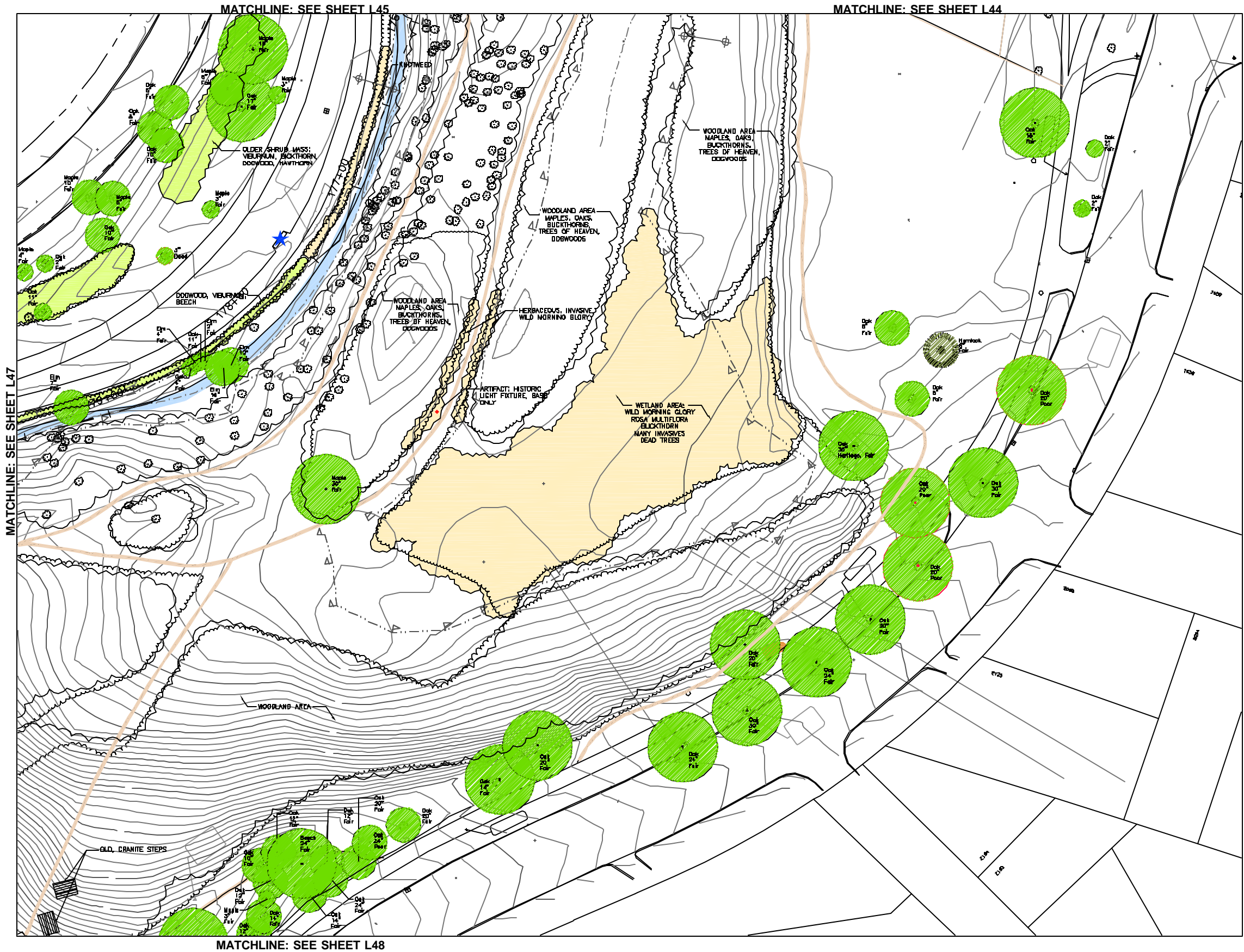
Boston and Brookline, Massachusetts

REVISIONS		
NO.	DATE	REMARKS
A	3/1/01	

DRAWING TITLE
Inventory and Analysis
VEGETATION /
EROSION



DRAWN BY: MC, LM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.
L45



LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

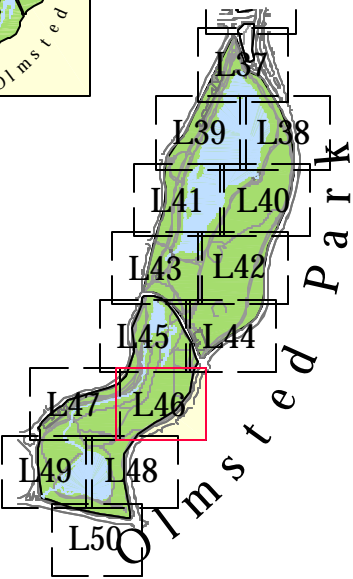
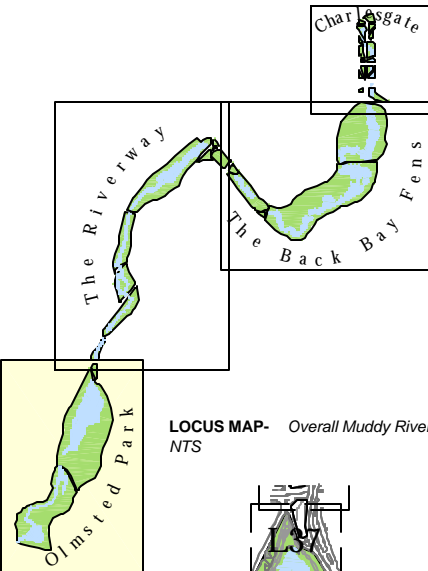
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



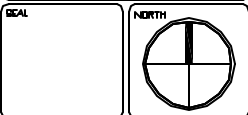
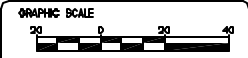
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NO.	DATE	REMARKS
A	3/1/01	

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Inventory and Analysis
VEGETATION /
EROSION



DRAWN BY: MC, MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.
L46

MATCHLINE: SEE SHEET L45



MATCHLINE: SEE SHEET L49

MATCHLINE: SEE SHEET L48

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

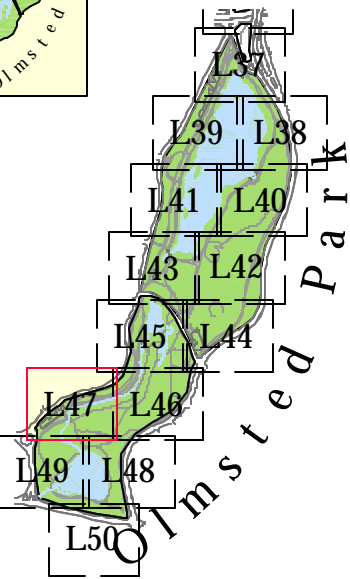
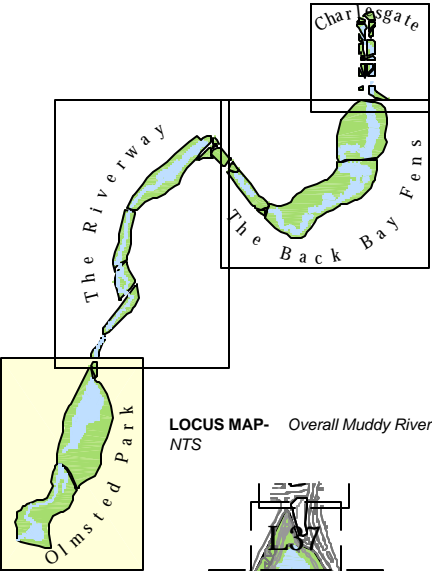
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



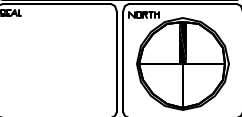
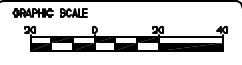
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Boston and Brookline, Massachusetts

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A	3/1/01	

DRAWING TITLE
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VEGETATION /
EROSION



DRAWN BY: M.C. MM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'
L47

MATCHLINE: SEE SHEET L49

MATCHLINE: SEE SHEET L47

MATCHLINE: SEE SHEET L46



MATCHLINE: SEE SHEET L50

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

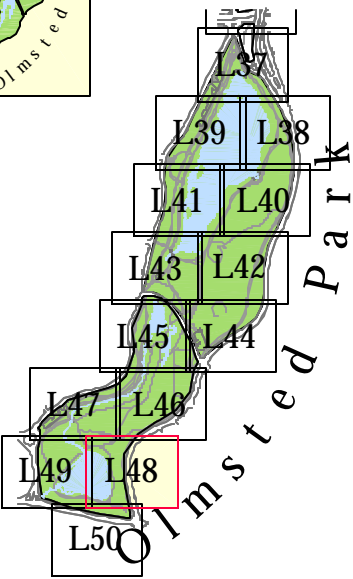
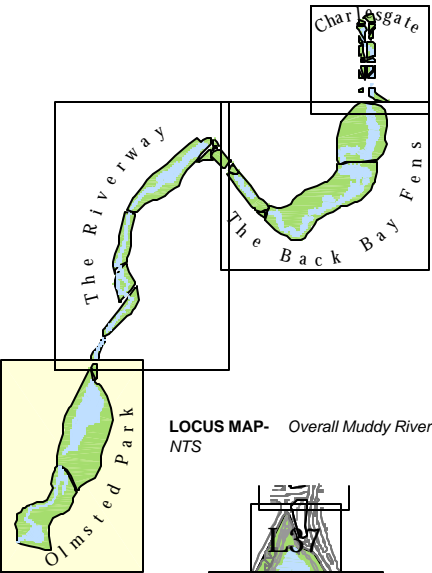
MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA



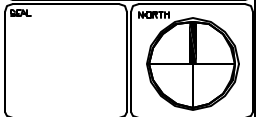
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Boston and Brookline, Massachusetts

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DRAWING TITLE
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VEGETATION /
EROSION



DRAWN BY: MC, MN
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=60'

L48



MATCHLINE: SEE SHEET L47

MATCHLINE: SEE SHEET L50

MATCHLINE: SEE SHEET L48

LEGEND
INVENTORY AND ANALYSIS

VEGETATION

TREES

DECIDUOUS TREE

EVERGREEN TREE

TREE MASS

SHRUBS

MASS OF RESTORED PLANTING

MASS OF SHRUBS

INVASIVE PLANT COLONY

EROSION

BARE LAWN

EROSION AREA

Symbol for Deciduous Tree

Symbol for Evergreen Tree

Symbol for Tree Mass

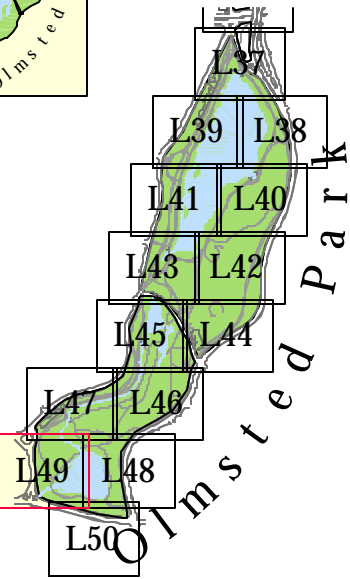
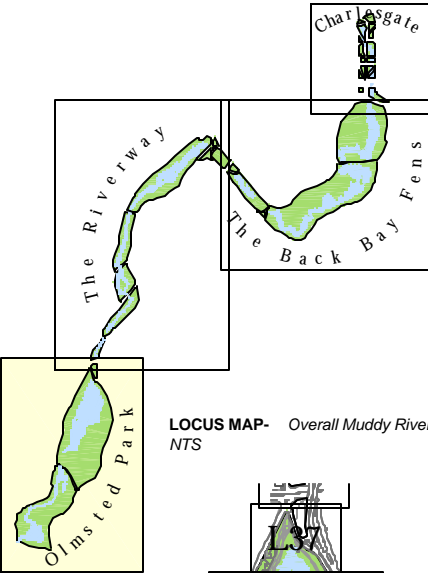
Symbol for Mass of Restored Planting

Symbol for Mass of Shrubs

Symbol for Invasive Plant Colony

Symbol for Bare Lawn

Symbol for Erosion Area



LOCUS MAP - Olmsted Park NTS

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VEGETATION /
EROSION


DRAWN BY: MO, NM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'
DRAWING NO.
L49





LEGEND
INVENTORY AND ANALYSIS

VEGETATION


TREES


DECIDUOUS TREE  Sycamore, Dogwood

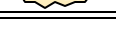
EVERGREEN TREE  Spruce, Fir, Redwood

TREE MASS 


SHRUBS


MASS OF RESTORED PLANTING 

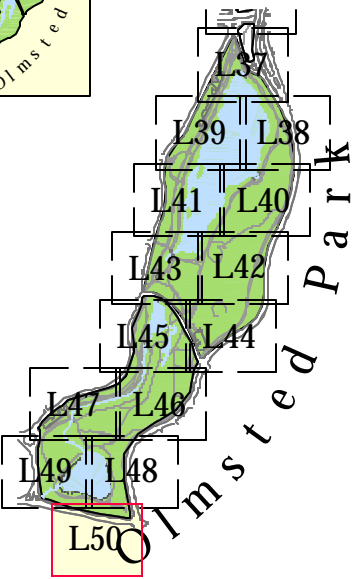
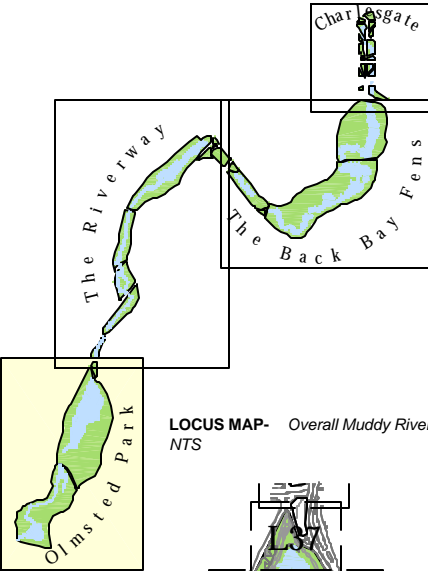
MASS OF SHRUBS 

INVASIVE PLANT COLONY 

EROSION

BARE LAWN 

EROSION AREA 



LOCUS MAP-
NTS

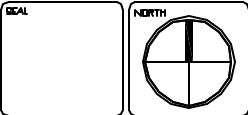
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VEGETATION /
EROSION



DRAWN BY: MC, LM
CHECKED BY: MP
DATE: 11/21/00
SCALE: 1"=80'

L50

**Appendix H: Wildlife Habitat Evaluation and Vegetation
Assessment for the Emerald Necklace,
Boston, Massachusetts**

Wildlife Habitat Evaluation and Vegetation Assessment

March 1, 2001

Emerald Necklace Boston, Massachusetts

Camp Dresser & McKee, Inc.
One Cambridge Place
50 Hampshire Street
Cambridge, Massachusetts 02139

LEC Environmental Consultants, Inc.

3 Otis Park Drive
Bourne, MA 02532
(508) 759-0050
(508) 759-0013 Fax

7 Kimball Lane, Building D
Lynnfield, MA 01940
(781) 245-2500
(781) 245-6677 Fax



AN ENVIRONMENTAL SYSTEMS COLLABORATIVE



December 13, 2000

Express Mail

Bruce Conklin
Camp Dresser & McKee, Inc.
One Cambridge Street
50 Hampshire Street
Cambridge, Massachusetts 02139

**Re: Wildlife Habitat Evaluation
Emerald Necklace
Boston, Massachusetts**

[J EC File: CDM/9213.01]

Dear Mr. Conklin:

LEC Environmental Consultants, Inc. (LEC) is pleased to provide you with the following report detailing our findings of current habitat conditions and species utilization along the Emerald Necklace in Boston, Massachusetts. The habitat evaluation was conducted in accordance with the *Massachusetts Wetlands Protection Act* Regulations (310 CMR 10.54 (4) (a) and 10.60) and DEP's Wetland Program Policy Guidelines (DEP Wetlands Program Policy 88-1 and Wetlands Wildlife Advisory #2, 1988), as well as floral and faunal inventory. The study site comprised the three primary links of the Emerald Necklace: Olmsted Park, the Riverway and Back Bay Fens.

LEC conducted a baseline survey of species, i.e. avian, mammals, aquatic and terrestrial invertebrates/vertebrates, fish, amphibians, and reptiles, to ascertain population diversity and densities. In addition, LEC mapped vegetation cover types and noted habitat potential throughout the study site. Given the limited temporal scale of this particular study, projecting habitat potential through established vegetative communities is an effective methodology from which to infer species utilization.

The Emerald Necklace is an intensely utilized urban park affording the city resident access to the watercourse as well as continuous green space for human and domestic animal recreation. Given the intense development surrounding the park system, the Emerald Necklace is proof positive of the resiliency of nature. However, decades of neglect have left their scar on the area, the most visible of which is a 5-acre stand of common reed (*Phragmites australis*) constricting the flow through the Back Bay Fens, as well as reducing the diversity of species utilization of this area. Other exotics are present in abundance throughout the Emerald Necklace, both floral and faunal; Canadian geese, Japanese knotweed (*Polygonum cuspidatum*), Yellow-flag iris (*Iris pseudacorus*), English sparrows, Glossy buckthorn (*Rhamnus frangula*) and European buckthorn (*Rhamnus cathartica*), to name but a few. As aggressive exotic monocultures invade this or any ecosystem, diversity of species utilization will decline. The decline in the diversity of species utilization is due to a lack of structural heterogeneity, or variability in height and width of vegetation, of an ecosystem, and either the inability to adapt or intensive energy requirements of adaptation to introduced vegetation. Accordingly, to preserve or enhance diversity of species utilization, one must take a "bottom-up" approach, specifically by establishing a diversity of vegetative species throughout the ecosystem, which will in turn presume species diversity and utilization.

The following report documents the existing conditions of wildlife habitat throughout the three primary links of the Emerald Necklace. LEC has included the baseline data of species observed throughout the study period. Potential species utilization has been extrapolated from existing vegetation cover types. Vegetation management techniques and restoration suggestions for each of the three segments of the Necklace are proposed. The landscape of the Emerald Necklace transitions from a more natural system (Olmsted Park) to a man-made environment (Riverway, Back Bay Fens) as one moves downstream. The following report describes the links of the Emerald Necklace in that fashion, from the natural to the scripted landscape.



Thank you for the opportunity to provide these services. Should you have any questions or require additional information, please do not hesitate to call LEC (508) 759-0050.

Sincerely,

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1. Introduction

The following report documents the findings of a wildlife habitat evaluation of the Emerald Necklace in Boston, Massachusetts. The wildlife habitat evaluation was performed by LEC Environmental Consultants, Inc. (LEC) as part of the Muddy River restoration project sponsored by the City of Boston Parks and Recreation Department. The habitat evaluation was conducted in accordance with the *Massachusetts Wetlands Protection Act* Regulations (310 CMR 10.54 (4) (a) and 10.60) and DEP's Wetland Program Policy Guidelines (DEP Wetlands Program Policy 88-1 and Wetlands Wildlife Advisory #2, 1988). This report describes existing habitat conditions and species utilization throughout the three primary links of the Emerald Necklace (Olmsted Park, the Riverway, and Back Bay Fens). Given the limited temporal scale of this habitat evaluation, species utilization was inferred through established vegetation cover types in addition to direct observations. Vegetation management techniques and restoration strategies for the entire Emerald Necklace ecosystem are proposed.

2. Study Site

The Muddy River originates at the outlet of Jamaica Pond and flows 3.5 miles in a northeasterly direction to its confluence with the Charles River. The watershed is 5.6 mi² in area, and limited gravity driven pressure gradient; over the course of the 3.5-mile length of the Muddy River, the river drops 58-feet. However, a 57-foot drop is incurred within the first 100 feet of the river between the outlet of Jamaica Pond and the inlet to Wards Pond. The gradient over the remaining 3-miles is minimal to non-existent.

The site has changed significantly since Fredrick Law Olmsted first designed and implemented the park for the City of Boston in the late 19th century. The watercourse at that time was tidally driven. While the park is highly degraded in areas, with dense colonies exotic vegetation and active erosion, the overall palette for restoration is clean, as the 3.5 miles of contiguous open space is largely intact.

3. Methodology

LEC traversed each habitat type in its entirety and the surrounding periphery on foot. Data were collected on the vegetative communities and landforms, with emphasis given to wildlife habitat value. Identification of vegetation included assessing the structural heterogeneity of the plant communities, i.e. the canopy, shrub, and groundcover layers, with special consideration given to the presence of snags, cavities, burrows, basking sites, and other outstanding features. Actively eroding areas and intensively disturbed areas were noted. The Emerald Necklace ecosystem was assessed according to habitat cover type, including forested upland, manicured landscaping, riparian shrub and emergent wetland vegetation. Habitat value was assessed using the above criteria, creating the framework for this report.

Adjacent to the watercourse, the abundance and diversity of all animals observed (by sight and/or sound) during the assessment were recorded along with any other evidence of habitat use including tracks, scat, feathers, bone fragments, and browse marks. Wind speed, temperature, cloud cover, wildlife vocalization, and general habitat structure and composition were noted. LEC utilized a Coffelt Manufacturing Mark-10 electroshocking apparatus and a 20' by 5' seine to sample the aquatic environment. The aquatic environment was sampled extensively throughout the Back Bay Fens and Olmsted Park; however the nature of the sediments (i.e. soft) within the Riverway proper

precluded aquatic biota sampling. Temporarily stunned by the electroshock apparatus, fish were identified, measured and returned to the aquatic environment with no mortality.

4. Existing Conditions

The following sections document existing conditions of wildlife habitat of the Emerald Necklace. Wildlife species observed throughout the survey are listed in Appendix B, Species observations. General habitat structure, composition and potential are discussed below.

4.1 Olmsted Park

Olmsted Park is comprised of Wards Pond, Spring Pond, the Babbling brook, Willow Pond, and Leverett Pond, in addition to a bordering vegetated wetland (BVW) area that feeds Spring Pond through surface flow. Spring Pond was created by Frederick Law Olmsted as one of three proposed Natural History Pools. Currently, this area may be considered one of the more desirable areas for wildlife along the Emerald Necklace, specifically because of the diversity of habitats present and the isolated and protected nature of the BVW feeding Spring Pond. In contrast to the majority of the Emerald Necklace, minimal manicured lawn exists in Olmsted Park and the landscape is more natural and self-sustaining.

The Massachusetts Division of Fisheries and Wildlife Natural Heritage Endangered Species Program maps Olmsted Park to contain two species of rare wildlife (Boston South quadrangle, WH 186) (Appendix A, Figure 2). The rare state-listed species that occur in the vicinity of the park are the Pied-billed Grebe (*Podilymbus podiceps*) and the Threespine Stickleback (*Gasterosteus aculeatus*). The presence of the Threespine Stickleback was corroborated with positive identifications in three locations in Olmsted Park. However, neither direct observations of the Pied-billed Grebe, nor nesting sites of the animal were confirmed. The Pied-billed Grebes travel north in the spring and summer to breed. However, nesting occurs erratically, as a pair may breed in a suitable area one year and never return. Accordingly, it is likely that the Pied-billed Grebe is an occasional visitor to the area.

4.1.1 Wards Pond

Wards Pond, situated at the southern most section of the Emerald Necklace, is naturally protected from urban noise by the geologic knob and kettle formation in which it lies, i.e. steep embankments. The Wards Pond area is not a heavily used pedestrian corridor compared to other areas along the Necklace, and the majority of people who frequent the area do so for recreational purposes. These factors in concert with a healthy assemblage of vegetation lend to the area's wildlife habitat value, as evidenced by the diversity of species observed in numerous visits to the pond.

Wards Pond is fed by an overflow from Jamaica Pond, as well as groundwater discharge. Vegetation associated in the periphery of this pond is on the whole in a natural state, and may be characterized as structurally heterogeneous, with aquatic submergents and emergent, groundcover, shrub, sapling, and canopy vegetation. A nearly complete band of swamp loosestrife (*Decodon verticillatus*) (emergent vegetation) encircles the pond with a variety of shrubs on the periphery including glossy buckthorn (*Rhamnus frangula*), weeping willow (*Salix babylonica*), river birch (*Betula nigra*), gray birch (*Betula populifolia*), paper birch (*Betula papyrifera*), arrowwood (*Viburnum dentatum*), and tulip tree. There are significant clusters of jewelweed (*Impatiens capensis*) in patches with small patches of Japanese knotweed (*Polygonum cuspidatum*) invading and some multiflora rose (*Rosa multiflora*), as well as narrow-leaved cattail (*Typha angustifolia*) on the southwestern bank. Other species such as silky dogwood (*Cornus amomum*), blue-flag iris (*Iris versicolor*), sensitive fern (*Onclea sensibilis*) and scattered patches of purple loosestrife (*Lythrum salicaria*), and buttercup are also present.

Groundwater discharge along the southern perimeter of the pond, adjacent to and beneath the boardwalk, is creating an elevated wetland system. Individuals of arrowwood are also found in this area with red maple (*Acer rubrum*) saplings, and scattered individuals of common elderberry (*Sambucus canadensis*). On the embankment at the

southern section of Wards Pond, a significant stand of tatarian honeysuckle (*Lonicera tatarica*) exists with staghorn sumac. Glossy buckthorn and Japanese knotweed form thick stands of vegetation along the southern embankment, and along with tree-of-heaven (*Ailanthus altissima*) are the predominant exotics in this area. A canopy of mature trees exists on the northern and western portions of the pond, dominated by black oak (*Quercus velutina*).

The water clarity within the pond is the highest compared to other areas of the Necklace. Factors that help to maintain the high water quality levels in Wards Pond are the lack of direct discharge from storm drains, the depth of the pond, and the established vegetation surrounding the pond. Only one area on the northwestern shoreline of Wards Pond is denuded of vegetation. In addition, the Canada Goose (*Branta canadensis*) population resident to Leverett Pond and areas downstream has not descended upon Wards Pond. The goose absence decreases the potential for the system to become eutrophic, as a resident population of geese leads to an abundance of fecal material and detritus from public feeding of the animals and negatively impacts the water quality in affected/infested areas. This scenario is documented downstream in Leverett Pond, where public feeding of the resident goose population has created a positive feedback mechanism that negatively affects water quality. The mechanism breaks down as follows:

1. Residents feed geese from pond shoreline.
2. Feeding areas become denuded of vegetation with continued and increased public access.
3. Goose population increases with continued and increased public feeding.
4. Water quality decreases with direct discharge of goose fecal material and sediment (active erosion with non-existent vegetative cover).
5. Breakdown of fecal material by bacteria reduces the free oxygen in the watercolumn available to aquatic species.
6. Nutrients released through fecal material decomposition supports algal blooms, which increases turbidity and the biological oxygen demand, and disturbs the production/respiration balance in the ecosystem.

This type of mechanism can be broken by actively planting shrub vegetation adjacent to the shoreline, which limits pedestrian access and discourages shoreline access by geese. Detailed suggestions follow in Section 6.1.4.

Species observed in Wards Pond include a variety of avian, insects, amphibians, and freshwater fishes, as tabulated in Appendix B, Species Observations. As mentioned above, the relative isolation of this area alongside a diverse vegetative community supports a diversity of wildlife habitat.

4.1.2 Nickerson Hill/ Babbling Brook/ Spring Pond

A steep drumlin, Nickerson Hill, between Wards Pond and Willow Pond provides high quality wildlife habitat to an array of mammals, birds and insects. The tree canopy is predominantly complete with open areas at the higher reaches of the hill. Vegetation on the north-facing slope is comprised of a well-developed sapling layer dominated by yellow birch (*Betula alleghaniensis*) and a diminished shrub layer. The shrub species are present where canopy gaps exist, and are dominated by glossy buckthorn (*Rhamnus frangula*) with scattered individuals of small Solomon's Seal (*Polygonatum biflorum*). Canopy species consist of northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), American beech (*Fagus grandifolia*), and river birch (*Betula nigra*). Saplings from the well-developed canopy are also present.

At the upper reaches of Nickerson Hill, gaps in the canopy give way to an assemblage of meadow species consisting of various grasses (Family POACEAE), fescues, path rush, orchard grass, asters, in addition scattered patches of bittersweet and staghorn sumac. Vegetation on the southern slope consists of a mature canopy of black oak (*Quercus velutina*), northern red oak (*Quercus rubra*) and white oak (*Quercus alba*), and a shrub layer of glossy buckthorn (*Rhamnus frangula*).

The relative isolation of Nickerson Hill provides wildlife habitat, in addition its intrinsic features support species utilization. The exposed soils on the pathways weaving through Nickerson Hill provide a source of sediment to seed eating birds, such as the Field Sparrow (*Spizella pusilla*), Song Sparrow (*Spizella melodia*) and the Chipping Sparrow

(*Spizella passerina*), as well as nesting sites for a variety of avian species. The well-developed canopy provides a mast crop for a variety of avian and mammals, including American Crow (*Corvus brachyrhynchos*), Blue Jay (*Cyanocitta cristata*), Eastern grey squirrel (*Sciurus carolinensis*), meadow voles (*Microtus pennsylvanicus*), and Eastern chipmunk (*Tamias striatus*). The open-meadow type ecosystem provides habitat for meadow voles (*Microtus pennsylvanicus*) and moles, deer mice, Eastern cottontail (*Sylvilagus floridanus*), and insects, such as the field cricket (*Gryllus pennsylvanicus*), butterflies (Lepidoptera spp.) and ants (Hymenoptera spp.).

The babbling brook, upon exiting Wards Pond, is confined by moderately steep topography and flows adjacent to Pond Avenue and ultimately discharging into Willow Pond. The stream is shaded by a densely vegetated shrub community comprised of red maple saplings, arrowwood, silky dogwood, buckthorn, gooseberry (*Ribes hirtellum*), as well as herbaceous species jewelweed and skunk cabbage (*Symplocarpus foetidus*). A significant colony of Japanese knotweed lines the brook on the western side and provides a thick screen to adjacent Pond Avenue traffic. The dense vegetation provides a temperature control of the stream allowing higher dissolved oxygen concentrations with cooler temperatures. One area on the western side of Babbling brook, proximal to the confluence with Willow Pond, is completely denuded of vegetation, and actively contributing sediment to the stream. Water in the stream is approximately 4 – 6 inches deep and 2 – 3 feet wide on average.

A bordering vegetated wetland system exists adjacent to Jamaica Way in the vicinity of the previous location of MDC ice rink. This wetland system feeds into Spring Pond, the sole remainder of the 5 proposed natural history pools created by Olmsted in the late 1800's. This wetland system is a very dense entanglement of shrub swamp, dominated by purple loosestrife, narrow-leaved cattail (*Typha angustifolia*), climbing nightshade (*Solanum dulcamara*), jewelweed, and arrowwood. The removal of equipment upon the ice-rink closure increased the amount of standing water in the wetland for a period of time significant enough to result in a die-back of vegetation, specifically box elder (*Acer negundo*), black cherry (*Prunus serotina*), and red maple (*Acer rubrum*) trees, within the wetland. The increase in water contributed to high-energy flows and eroded a small channel between the wetland and Spring Pond exposing tree roots and depositing sand and gravel within this area. The channel transports water from the wetland to Spring Pond in times of overflow from episodic events or engineering failure (as with the MDC ice rink), and does not occur on a seasonal basis.

Spring Pond, a small, linear-shaped, shaded pond just upstream from Willow Pond, is habitat to the three-spine stickleback (*Gasterosteus aculeatus*), a small (maximum length = 10 cm) fish currently listed as a threatened species by the Massachusetts Division of Fish and Wildlife Natural Heritage and Endangered Species Program. The sticklebacks in Olmsted Park are considered to be the southern-most completely freshwater population of sticklebacks in the country. Sticklebacks were observed within Spring Pond, in the channel connecting Spring and Willow Ponds, and in Willow Pond at the outfall from Spring Pond.

Spring Pond contains water approximately 2 feet deep, and is fringed by glossy buckthorn, with red maple saplings and pin oak (*Quercus palustris*) on the periphery. While the pond does receive overflow discharge from the upstream wetland, the primary water source is groundwater, hence its name. Due to its source, the water in Spring Pond is clear and of high quality. Water exiting Spring Pond flows through a meandering two-foot wide channel and discharges directly into Willow Pond via a stone box culvert.

4.1.3 Willow Pond

Willow Pond, situated between Wards Pond and Leverett Pond, receives discharge from two sources, the babbling brook and Spring Pond. Vegetation surrounding Willow Pond is comprised of mature oaks with a sapling understory on the eastern side and a variety of shrubs, saplings and herbaceous species on the western side, including red-osier dogwood (*Cornus stolonifera*), sweet pepperbush (*Clethra alnifolia*), American bittersweet (*Celastrus scandens*) weeping willow (*Salix babylonica*) barberry, Japanese knotweed and Virginia rose (*Rosa virginiana*). A dense colony of herbaceous vegetation exists at the outfall from Babbling brook. The vegetation is confined to two small island

areas and is comprised of broadleaf arrowhead (*Sagittaria latifolia*), pickerelweed (*Pottrderia cordata*), barnyard grass (*Echinochloa crusgalli*), jewelweed (*Impatiens capensis*), purple loosestrife (*Lythrum salicaria*), three-square bullrush (*Scirpus americanus*) and manna grass (*Glyceria canadensis*). The western shoreline of Willow Pond is bordered manicured lawn with a shrub fringe, while the east is forested. Willow Pond exhibits evidence of environmental stresses from oil contamination. LEC was unable to sample aquatic species due to the thick organic material and soft sediments on the subsurface of Willow Pond.

4.1.4 **Leverett Pond**

Leverett Pond, the largest pond within Olmsted Park, is a long, linear shaped pond located at the northern end of Olmsted Park. The babbling brook discharges into Leverett Pond, although the brook is not day-lighted along its length from Willow Pond. A culvert on the southeastern side of the pond, in the vicinity of Daisy Field, also feeds into the pond. The areas surrounding the pond are vegetated by manicured lawn with a mature tree canopy. In the majority of areas, manicured lawn extends to the pond shoreline, although active planting of shrubs in the past few years along the western shoreline of the pond has replaced the lawn cover in some areas. The tree canopy is comprised of sugar maple (*Acer saccharum*), pin oak (*Quercus palustris*), sweet gum (*Liquidambar styraciflua*), black cherry (*Prunus serotina*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*) and box elder (*Acer negundo*). Shrub vegetation along the western bank dominated by purple loosestrife by scattered individuals of sweet pepperbush (*Clethra alnifolia*) and arrowwood (*Viburnum dentatum*).

A feature unique to Leverett Pond that provides excellent wildlife habitat is the three vegetated islands located on the western boundary of the pond. An Olmsted creation, the islands are vegetated by river birch (*Betula nigra*), Eastern poplar (*Populus deltoides*), paper birch (*Betula papyrifera*), white ash (*Fraxinus americana*), and tupelo (*Nyssa sylvatica*). The narrow channels between the shoreline of the pond and of the islands lend to the diversity of habitats available in Leverett Pond for aquatic species. Further, the islands provide excellent shade, as well as numerous overhangs, created by bank and vegetation, and cavities, providing excellent habitat for reptiles, amphibians and avian species. This habitat diversity leads to species diversity, which was evidenced by the variety of aquatic species found in Leverett Pond. Intraspecific comparison revealed a spectrum of sizes indicative of functional breeding and recruitment amongst the species observed (Appendix B). The preferred habitat for aquatic species within Leverett Pond was hard-bottomed areas adjacent to steep banks. The steep banks are conducive in micro-scale upwelling areas, which bolster atmospheric exchange and transport inorganic nutrients to the euphotic zone for production. The recent improvement of wire-mesh covered rocks along portions of the banks on the western bank of Leverett Pond supports aquatic habitat by increasing the surface area of the banks, which stimulates oxygen exchange, and promoting algal growth.

There are several areas in Leverett Pond that require immediate attention to improve the water quality. The most visible of these is a large island at the northern end of the pond that consists of sediment, primarily road sand, deposited by the Village Brook culvert. Discharge of sediments, including road sand, from the Village Brook drainage area negatively impacts water quality. Best management Practices should be improved in the watershed if restoration efforts are to have long-term positive benefits. Cobble swales that direct discharge to Leverett Pond also are an active sediment source to the pond. In addition, sediment from Daisy Field is being actively redeposited in Leverett Pond. Numerous areas are completely denuded of vegetation are contributing sediment to pond when overland flow occurs following a storm event. The erosion of these areas will increase the turbidity of Leverett Pond, inhibiting primary production and negatively impact the food web from its inception. One of the denuded areas on the western edge of the pond is frequently used for duck and goose feeding. As mentioned in Section 4.1.1, this activity is negatively affects the water quality in Leverett Pond.

4.2 Riverway

The Riverway area extends from Route 9 to the Back Bay Yard. A continuous footpath parallels the river along the eastern and western side of the river south of Route 9. The areas landward of the footpath are vegetated by a mature trees canopy and manicured lawn areas that occupy the groundcover to the river's banks in most areas. On the riverside of the footpath, the vegetation consists manicured lawn, with occasional ornamental shrubs. Aggressive monocultures, common reed (*Phragmites australis*) and knotweed, comprise the primary bank vegetation. *Phragmites* is an emergent plant growing within the watercourse, while Japanese knotweed require the dryer embankment conditions. The invasion of *Phragmites* has constricted the river's channel substantially in numerous areas along this portion of the Necklace, i.e. between Brookline Avenue and Jamaica Way, the eastern channel through the Island Bridges area, and the eastern side of the Muddy River between the Chapel Street Bridge Area and Back Bay Yard. Colonization of *Phragmites* increases sediment deposition in affected areas through sediment trapping (Section 6). Sediment deposition will further impede the ability of the river to carry its flow downgradient through coincident decreases in the water column and channel width. The existing condition descriptions of the Riverway are divided into two sections, south and north of Longwood Avenue. Species observations of the Riverway are listed in Appendix B.

4.2.1 Route 9 to Longwood Avenue

A mature tree canopy comprised of northern red oak (*Quercus rubra*), American elm (*Ulmus americana*), and white ash (*Fraxinus americana*) exists adjacent to the eastern bank of the river, and provides habitat to avian species and squirrels. However, wildlife habitat is variable south of Brookline Avenue (Riverway South), as a segment of this stretch is culverted. The river daylight's north of Washington Street, where the channel is lined with rip-rap.

The rip-rapped section of the river, while narrow, provides significant wildlife habitat because of the diversity of vegetation present and the high degree of channel entrenchment, i.e. steep banks, that provide shelter and isolation from the dense urban environment surrounding this area. The river is completely shaded by a mature canopy of American elm (*Ulmus americana*), white ash (*Fraxinus americana*), and red maple (*Acer rubrum*). Shrub species present along the banks include glossy buckthorn (*Rhamnus frangula*) and arrowwood (*Viburnum dentatum*), with some Japanese knotweed (*Polygonum cuspidatum*) and tree-of-heaven (*Ailanthus altissima*). A sole red mulberry (*Morus rubra*) provides a nectar source for nectar feeders such as hummingbirds, butterflies and bees, as well as an abundant mid to late summer fruit source. Downstream from this section, as the river parallels Brookline Avenue, the channel is completely constricted by *Phragmites*.

North of Brookline Avenue, the river bifurcates and rejoins at the pedestrian bridge just south of Netherlands Road. The eastern branch of the channel is choked by *Phragmites*, while the western channel is clear. *Phragmites* colonization and growth can be inhibited by shade, and the mature canopy cover along the western channel provides adequate shade to impede growth. *Phragmites* also tends to colonize areas with shallow banks. This is evidenced by the growth on shallow banks of the eastern channel of the river, compared to no growth adjacent to the steep bank of the western channel. The mature tree canopy of black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), and pin oak (*Quercus palustris*) on the Riverway Island provides habitat to avian species and small mammals. Though the groundcover consists primarily of manicured lawn, the seed source of the oak trees provides a food source for these animals.

Downstream of the island bridges area, the channel is linear (man-made) and the vegetative cover types consist of a mature oak canopy, with manicured lawn groundcover. The shrub layer consists of Japanese knotweed, with scattered individuals of gray birch (*Betula populifolia*). The mature tree canopy shades the watercourse and prevents the colonization of *Phragmites*. Cobble swales contribute sediment to the river in this area decreasing the water quality. The raceways primarily transport stone dust from the walkway paralleling the river.

4.2.2 Longwood Avenue to Old Sears Tower

Vegetation along this segment of the river is comprised of a mature oak canopy landward of the footpath. *Phragmites*, river birch (*Betula nigra*), glossy buckthorn and gray birch (*Betula populifolia*) dominate the bank vegetation, and provide a thick screen in areas. In addition to *Phragmites* and Japanese knotweed, yellow iris (*Iris pseudacorus*), a non-native invasive species, is present in the northern section of the Riverway. Similar to Leverett Pond, public waterfowl feeding areas are completely denuded of vegetation and contributing sediment and fecal material directly into the watercourse.

Two densely vegetated islands located on the eastern side of the Riverway. Canopy vegetation consists of red maple (*Acer rubrum*), river birch, paper birch, pin oak (*Quercus palustris*) and weeping willow (*Salix babylonica*). The islands increase habitat diversity for aquatic and land animals. In addition, the islands provide a significant refuge for species within this segment of the Necklace due to the minimal amount of open space and heavy vehicular traffic at this location.

Standing tree boles in the northern portion of the Riverway provide excellent habitat to avian cavity nesters, such as the Northern Flicker (*Colaptes auratus*). The overhangs and snags from the island provide basking and perching sites for reptiles and waterfowl species. Three bur oak trees (*Quercus macrocarpa*) are also present in this area.

Phragmites may provides limited wildlife habitat. For instance, thick stands of the reed creates a thick screen along the banks of the river. Screening is important in urban areas to dampen the constant noise. A wall of *Phragmites* also provides escape cover. However, the negative effects of *Phragmites* far outweigh the positives. The common reed does not provide essential wildlife habitat functions, i.e. food source, nesting or breeding habitat. Non-native aggressive exotics reduce the overall species diversity in affected areas, because only highly adaptable or urban species can adjust. The problems associated with urban wildlife species parallel the invasive vegetation as these species breed quickly and establish large populations that are without natural predators. The large populations degrade habitat with an abundance of waste material, and because the volume of waste outweighs the natural capacity of the system, much of the material is not decomposed. An ecosystem can quickly become out of balance through the introduction of non-native exotics.

While the Emerald Necklace flows northeast from Wards Pond to its confluence with the Charles River, the river meanders at a 90° angle at the Old Sears Tower and flows southeast for 0.5 mi. The river returns to a northeast trend with a 90° bend at Clemente Field. At the Back Bay Yard, the river flows through 2-six foot diameter culverts. The configuration of the channel, i.e. the inadequately designed culverts are responsible for upstream flooding problems.

4.3 Back Bay Fens

The Back Bay Fens extends from Old Sears Tower to Charlesgate. The Back Bay Fens is used intensively by the public due to the wide flanks of parkland adjacent to the river. This area is intensely manicured and landscaped and contains a war memorial, a ball field and playground, a rose garden and an expansive community garden, the Victory Gardens. The dominant vegetation within this area is common reed (*Phragmites australis*), which occupies in excess of 5-acres of the watercourse. The extent and density of *Phragmites* screens park vistas from footbridges and road bridges. The *Phragmites* is in excess of 20-feet tall in areas, and the width of the stands range from 5 to 25 feet. By creating a thick screen between the river and the park, the presence of *Phragmites* fosters illicit activity and degrades overall park quality with the increases in rubbish and human odors associated with this type of behavior. Additionally, the public safety issue and rubbish reduces the aesthetic experience for the city resident. The Back Bay Fens will be described in two sections, Old Sears Tower to Clemente Field and Clemente Field to Charlesgate. Species observations for this area are described in Appendix B.

4.3.1 Old Sears Tower to Clemente Field

As discussed in Section 4.2.2, the river flows southeast to Clemente Field. At the Back Bay Yard the river is directed through 2 culverts. The river daylight is approximately 0.13 mi. southeast of the Old Sears Tower. Upon daylight, the river appears like a linear pond, as flow is directed through culverts just a short distance downstream (0.06 mi.) at Avenue Louis Pasteur. Though small, this area provided ample wildlife habitat with mature canopy vegetation and numerous basking and perching sites within the watercourse. Further, the entrenched channel provides seclusion for wildlife and provides a buffer from the noise of heavy vehicular traffic that parallels the river on either side.

The mature canopy consists of river birch (*Betula nigra*), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), pin oak (*Quercus palustris*), black oak (*Quercus velutina*), silver maple (*Acer saccharinum*), and norway maple (*Acer platanoides*). Shrub community is dominated by glossy buckthorn (*Rhamnus frangula*) with scattered individuals of arrowwood (*Viburnum dentatum*), honeysuckle and saplings from the canopy. Due to the shade cover and relatively steep banks, no *Phragmites* is present. Minimal Japanese knotweed is present.

The river daylight is southeast of Louis Pasteur, and two patches of *Phragmites* are present where gaps in the canopy exist. Canopy vegetation is similar to the upstream assemblage. Sediments are "soft" with a high amount silt and organic material.

4.3.2 Clemente Field to Charlesgate

At Clemente Field, the river bends 90° to flow northeast towards the Charles River. Canopy vegetation is comprised of pin oak (*Quercus palustris*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*) and weeping willow (*Salix babylonica*). Hackberry (*Celtis occidentalis*), arrowwood (*Viburnum dentatum*), and glossy buckthorn (*Rhamnus frangula*). Blue flag (*Iris versicolor*) and tatarian honeysuckle (*Lonicera tatarica*) are also present. Small patches of *Phragmites* exist coincident with canopy gaps. Northeast of Clemente Field, the channel meanders through the Back Bay Fens proper. Approaching the Museum of Arts, the canopy vegetation transitions to aggressive sapling along the banks, and no mature trees are present. Shrub vegetation consists of arrowwood (*Viburnum dentatum*), buttonbush (*Cephalanthus occidentalis*), with climbing nightshade (*Solanum dulcamara*) throughout. The submerged aquatic species, millfoil, is present throughout the watercourse.

The lagoon directly opposite the Museum of Fine Arts is the one of the few hard-bottomed areas within the Back Bay Fens. The hard bottom and steep banks provide wildlife habitat for fish species, such as the common carp (*Cyprinus carpio*), some in excess of 2-feet, pumpkinseed sunfish (*Lepomis gibbosus*) and bluegill sunfish (*Lepomis macrochirus*). The majority of fish activity observed was sessile, with little active swimming, most likely to conserve oxygen. Vegetation surrounding the lagoon is dominated by purple loosestrife (*Lythrum salicaria*), false indigo (*Amorpha fruticosa*), and hawthorn (*Crataegus spp.*). The hawthorns provide an excellent nectar source for nectar feeders. The tree canopy is comprised of pin oak (*Quercus palustris*), northern red oak (*Quercus rubra*), gray birch (*Betula populifolia*) and ornamental cherries.

Downstream of the lagoon area, the river flows northeast. The vegetation on either side of the river is weeping willow (*Salix babylonica*), pin oak (*Quercus palustris*), northern red oak (*Quercus rubra*), false indigo (*Amorpha fruticosa*), tupelo (*Nyssa sylvatica*), box elder (*Acer negundo*) and honey locust. Manicured lawn is the primary groundcover throughout the Back Bay Fens. Adjacent to the Story Brook Gatehouse is a large island of road sand deposited from the adjacent culvert. The deposit is the result of road sanding and decreases the channel capacity of the river thereby restricting flow. The deposit eliminates Land Under Waterbodies and habitat for aquatic species, though it does provide perching sites for water birds, such as Herring Gulls (*Larus argentatus*), Mallards (*Anas platyrhynchos*) and the Canada Goose (*Branta canadensis*).

The meandering river is flanked by dense colonies of *Phragmites* from the Stony Brook Gatehouse north to Charlesgate. The only exception to the thick stands of *Phragmites* is an equally dense patch of narrow-leaved cattail (*Typha angustifolia*) interspersed with purple loosestrife (*Lythrum salicaria*) on the western bank of the river south of the Agassiz Bridge. The stands of *Phragmites* range in width from 5 to 25 feet and reeds are in excess of 20 feet tall. These thick colonies of *Phragmites* create an almost impenetrable barrier along the banks of the river, eliminating historic vistas, reducing wildlife species utilization, increasing the potential for deviant behavior and decreasing the aesthetic experience of the park for city residents.

One area adjacent to Mother's Rest demonstrates that *Phragmites* may be outcompeted by other vegetation if enough shade exists. In this area, *Phragmites* reeds are stunted by the shade of a silver maple (*Acer saccharinum*). The silver maple's preferred habitat is riparian zones. This rapid growing species establishes itself along the river banks, and grows to significant heights in a relatively short amount of time. This portion of the Back Bay Fens, approximately 40 linear feet, is the only spot north of Stony Brook gatehouse where *Phragmites* is absent.

The wildlife habitat of the Back Bay Fens is diminished due to the presence of *Phragmites*. As discussed above, the presence of *Phragmites* reduces overall species utilization for a number of reasons: the absence of diversity, absence of structural heterogeneity, and most importantly lack of viable habitat. *Phragmites* does not provide a food source, or nesting habitat for the majority of avian species known to frequent the area. *Phragmites* was observed to provide perching sites for Red Winged Blackbirds and English Sparrows, as well as limited escape cover for English sparrows and Blue Jays (*Cyanocitta cristata*). Perching will occur regardless of vegetation type, as the activity is morphology dependent rather than nutrient dependent. As habitat characteristics diminish, the diversity of species will decline because the ecosystem can not provide essential services.

4.4 Charlesgate

Charlesgate extends north from the Back Bay Fens to the river's confluence with the Charles River. The Charlesgate area is fragmented from Back Bay Fens by the Massachusetts Turnpike, which trends in an east-west direction. Charlesgate is not frequently visited by the public, due to the sinuous configuration of roads, highways and bridges that weave through the 0.25-mile stretch of the river. The banks of the river, i.e. from mean high water to mean low water, are stabilized with rip-rap. The banks of the river are vegetated with mature trees, including red pine (*Pinus resinosa*) and American elm (*Ulmus americana*). Stumps along the flanks of the river remain from felled American elm trees afflicted with American elm disease. While the Muddy River is daylighted through the majority of the Charlesgate area, the northern-most section flows through a culvert, for a distance less than 0.5 miles, to the river's confluence with the Charles River. Due to intensity of road infrastructure and minimal vegetation, the capability of this area to provide basic wildlife habitat is impaired.

5. Ecosystem Functions and Values

The shifts in ecosystems from natural and diverse assemblages of vegetation or fauna to ecosystems dominated by one species, either native or exotic, have been documented for some time and may be linked to human disturbances. These ecosystem shifts are documented to occur with changes in vegetation through changes in hydrologic regime of an ecosystem, e.g. saltmarsh cordgrass (*Spartina patens*) to common reed (*Phragmites australis*) with changes in salinity, but they may also occur with increases in nutrient loading or the introduction of exotic faunal species, i.e. zebra mussels or European Starlings (*Sturnus vulgaris*). Perturbations in ecosystem balance can rapidly deteriorate the quality of natural systems for two reasons, lack of predators for exotic fauna and the inability of native species to utilize the monotypic and/or non-native invasive vegetation for primal requirements.

The intensity of development surrounding the Emerald Necklace, the numerous culverts within the Muddy River watershed and associated sediment and nutrients, and the low gradient of the river flow, combined with the absence of

routine maintenance of the historic landscape allowed for the introduction of non-native exotics, Japanese knotweed and *Phragmites*. Glossy buckthorn (*Rhamnus frangula*) and tree-of-heaven (*Ailanthus altissima*) were formally introduced at the early part of the 20th century.

Phragmites expansion has been documented in freshwater, oligohaline and mesohaline tidal wetlands. Reproduction of *Phragmites* is controlled by rhizomes, which produce new shoots through nodal roots, rather than by seed germination (Chambers, 1999). Nutrient loading in wetland systems may be responsible for *Phragmites* expansion, as the reed appears to outcompete tidal wetland plants for other limiting resources, i.e. light, when nutrients are in excess (Levine, 1998). This scenario has been documented in the Florida Everglades with a shift from a *Cladium*-dominated wetland to one dominated by *Typha* with increases in phosphorus. *Phragmites* can be a fast-growing species, with rhizome growth up to 30-feet per annum in nutrient-rich sites; average growth rates are 2-3 feet per year.

The expansion of *Phragmites* into North American wetlands has been documented to decrease overall plant diversity. The capacity of *Phragmites* wetlands to provide resting, feeding, and breeding areas are greatly diminished compared to the pre-*Phragmites* ecosystem. Additionally, the coincident change in habitat structure and decrease in vegetation diversity excludes utilization by large wading birds, and marsh specialist species are replaced by generalists, leading to an overall reduction in species richness (Benoit & Askins, 1999).

Phragmites dominated wetlands are associated with high sedimentation rate (Harrison & Bloom, 1977). This feature may be appealing in marshes subject to sea-level rise. However, it is unattractive in areas with flooding problems, because *Phragmites* will impede the natural flow of the watercourse. This happens in two ways; thick stands of *Phragmites* occupy a percentage of the watercourse and narrow the channel, and the accelerated sedimentation rate caused by *Phragmites* reduces the watercolumn. Not only do these factors exacerbate flooding problems, but they also reduce access by aquatic species.

6. Proposed habitat improvements

The ecosystem of the Emerald Necklace will benefit from incremental changes in habitat structure, with the goal of rehabilitating the historical landscape in a manner that will allow nature to eventually take control of the rehabilitated ecosystem. Creation of a self-sustaining ecosystem is necessary to minimize the continual maintenance of the park. This is an ultimate goal that will not be realized until the majority of non-native invasive species have been eradicated. The removal of *Phragmites* will be greatly simplified if it can be done coincident with watercourse dredging.

When analyzing the potential for this urban ecosystem, realistic goals should be in place. This system will never be pristine; it is an area subject to a good deal of pedestrian traffic and is bounded by busy city streets for much of its fetch. Numerous culverts from densely developed urban areas discharge into the Muddy River. However, by implementing a habitat restoration protocol through vegetation management and in conjunction with implementation of Best Management Practices (BMP's), there is an excellent chance for the natural capacity of the ecosystem to improve.

Proposed habitat improvements are categorized into three units; *Phragmites* removal, habitat restoration and no-action. Few areas of the Emerald Necklace fall into the third category. The habitat improvements are organized by the three primary Necklace links, Olmsted Park, Riverway and Back Bay Fens.

6.1 Olmsted Park

Olmsted Park is the most natural region of the Emerald Necklace. However, improvements associated with BMP's are necessary to improve water quality. In addition, the removal of exotic vegetation, and stabilization of actively

eroding areas are necessary to improve the natural capacity of the resource area to provide wildlife habitat to a diverse assemblage of animals.

6.1.1 **Wards Pond**

Wards Pond is one of the more desirable ecosystems within the Emerald Necklace, and is in little need of restoration, with the exception of exotic vegetation removal. The removal of Japanese knotweed, Tree-of-Heaven, Glossy buckthorn, and Tartarian honeysuckle (*Lonicera tatarica*) in the southeastern portion of the pond and replacement with indigenous species will increase vegetative diversity in this ecosystem. The planted species can satisfy the wildlife requirements and the historic nature of the landscape by selecting compatible species from Olmsted's historic list. The denuded area on the northwestern shoreline negatively impacts water quality and could be reintroduced with indigenous species likely to survive the existing conditions, further stabilizing the area while providing valuable habitat.

6.1.2 **Nickerson Hill/ Babbling Brook/ Spring Pond**

These areas would benefit from the removal of exotic vegetation, namely Japanese knotweed along the banks of Babbling brook and the removal of Glossy buckthorn throughout Nickerson Hill and surrounding Spring Pond. Pathways throughout Nickerson Hill can be modified to retard erosion.

6.1.3 **Willow Pond**

The Willow Pond ecosystem has the highest potential for responding to an enhancement program. Two sources of clean water from Spring Pond and Babbling brook are the perfect ingredients to create a desirable ecosystem. The high-oxygen demand bottom sediments of Willow Pond degrade the aquatic habitat by increasing the biological oxygen demand and decreases oxygen concentration within the pond. Additionally, the bottom sediments contain high concentration of polyaromatic hydrocarbons (PAH's) and metals. Enhancement of the aquatic habitat through dredging will create a desirable habitat for fish populations and create another viable area for recreational fishing, in addition to the currently used Ward's Pond and Jamaica Pond.

The western shoreline of the pond can be enhanced by planting shrub vegetation, and removing the Purple loosestrife and American bittersweet (*Celastrus scandens*). The Japanese knotweed at the northern end of the pond detracts from wildlife habitat quality. Planted species should be selected based on habitat value, microhabitat requirements for specific species growth, and historic significance.

6.1.4 **Leverett Pond**

The shoreline of Leverett Pond could be enhanced by fostering a dense shrub layer along the banks of the pond. The removal of exotic vegetation, namely purple loosestrife (*Lythrum salicaria*) and glossy buckthorn (*Rhamnus frongula*) and replacement with indigenous vegetation will increase habitat diversity. In addition, the stabilization of actively eroding areas surrounding Leverett Pond, i.e. adjacent to Daisy Field and on the eastern bank of the pond, will improve water quality.

The planting of shrubs around the waterfowl feeding area on the western bank of the pond will discourage public access. The introduction of a dense shrub layer will discourage shoreline access from Canada Goose (*Branta canadensis*). In conjunction, public awareness placards might be placed along the walkway to discourage public feeding of the birds as well.

The removal of the large island created by road sand in the northern portion of the pond will increase the water quality and improve aquatic habitat within Leverett Pond. While this island provides perching sites for birds, the birds that frequent the island are large droves of Herring Gulls (*Larus argentatus*), Canada Goose (*Branta canadensis*) and Mallard (*Anas platyrhynchos*). The removal of this island will not reduce the desirability of this area

species, but instead will increase habitat for aquatic species. In conjunction, the routine maintenance of storm drains with regular street sweeping will also improve water quality.

6.2 Riverway

The Riverway section of the Emerald Necklace will benefit from complete *Phragmites* removal. The sections most in need of *Phragmites* removal are areas where the channel is completely constricted by the reed, specifically between Brookline Avenue and Jamaica Way, the eastern channel in the Island Bridges area, and at the Back Bay Yard area. Between Longwood Avenue and the Old Scars Tower, dense stands of *Phragmites* eliminate the historic vistas from pedestrian footbridges, road bridges and along the shoreline of the river. While some of these areas are relatively short in length, the existing *Phragmites* is a seed source for the establishment of other colonies. Dredging of the *Phragmites* rootstock will provide immediate results. However, without follow-up maintenance, these efforts will surely be futile.

The soft-bottom sediments of the Riverway contain a significant amount of silt and organic material and their removal would reduce the oxygen demand on the aquatic ecosystem. This goal can be achieved by dredging the watercourse. At the same time, the dredged channel should be shelved to provide areas for planting emergent vegetation. Planting emergent aquatic vegetation will increase the structural heterogeneity of the ecosystem, which is greatly lacking in this section of the river, and create habitat for reptiles, amphibians and avian species. The lack of shrub vegetation precludes the settlement of certain avian species, because the habitat requirements are not present. For instance, species such as the Gray Catbird (*Dumetella carolinensis*) and Yellow Warbler (*Dendroica petechia*) prefer shrubs 4-6' tall for nesting, few of which are present in this section of the Necklace. As a result, the bird is forced to leave the Necklace to find suitable nesting sites. The continual narrowing of vegetative species diversity will, with time, eliminate habitat for a variety of animal species as well as foster the propagation of urban animal species.

The shrub zone vegetation along the shoreline of the Riverway is dominated by either *Phragmites* (as emergent vegetation within the watercourse) or Japanese knotweed (along the banks of the river), the removal of these species along with the planting of shrubs conducive to wildlife will increase the available habitat. The denuded banks are responsible for contributing sediment to the watercourse, and the stabilization of these areas will reduce the suspended solid inputs. Additionally, a habitat enhancement program can be adopted to include the introduction of wildlife for nectar feeders and aesthetic values, as well as installing and maintaining nesting boxes for certain target species. If nesting boxes were to be installed in any area of the Emerald Necklace, the boxes must be diligently maintained in the springtime to ensure success of designated occupants. Planted species may be selected from a list of compatible species from both the historic and wildlife perspective and include such species as swamp azalea (*Rhododendron viscosum*), tupelo (*Nyssa sylvatica*), silky dogwood (*Cornus amomum*), witch-hazel (*Hamamelis virginiana*), and winterberry (*Ilex verticillata*).

A considerable amount of the suspended solid inputs to the Riverway originate from the stone dust pathways that parallel both sides of the river. The stone dust is transported to the river with minor amounts of rainfall. To prevent this, a small berm could be placed on the riverside of the pathway. In addition, the cobble swales are conducive to direct discharge of suspended solids to the watercourse. This occurs in two ways. The obtrusive swales exacerbate erosion through their imperviousness, which creates rivulets and gullies between the sides of the swales and the earthen areas surrounding the structures. The eroded material is deposited within the watercourse. Also, the long, linear structures directly discharge turbid water, primarily the stone dust from the pathway. The removal of the cobble swales will prevent further degradation of water quality. The swales present in the Back Bay Fens have the same affect on water quality.

6.3 Back Bay Fens

The Back Bay Fens portion of the Emerald Necklace requires an aggressive approach to invasive vegetation management, as well as maintenance to its heavily accessed parks and pathways. The degree to which *Phragmites*

has established itself within this area of the park presents a higher level of difficulty for eradication than elsewhere in the Necklace. In addition to *Phragmites* removal, the Purple Loosestrife present in certain areas, such as the Lagoon area and within the narrow-leaved cattail (*Typha angustifolia*) colony just south of Agassiz bridge, requires removal.

The removal of established *Phragmites* colonies, including root mats, will maximize the efficiency of the restoration process. The shape of the dredged channel could be conducive to planting emergent vegetation, from both a wildlife habitat and historical standpoint. Plantings in this area may be comprised of species such as winterberry (*Ilex verticillata*), silky dogwood (*Cornus amomum*), arrowwood (*Viburnum dentatum*), nannyberry (*Viburnum lentago*) and speckled alder (*Alnus rugosa*).

As with the areas upstream, the stabilization of actively eroding areas and removal of cobble swales will improve water quality within the Back Bay Fens. In areas where the natural topography necessitates the use of drains, French drains (i.e. crushed gravel) could be used in place of cobble swales to allow for natural seepage of surface runoff as opposed to channelized flow.

The prevention of active contributions of sediment to the watercourse is of greater importance given the area's history of flooding and the dense colonies of *Phragmites*. As discussed in Section 5, *Phragmites* dominated wetlands are effective entrappers of sediment and continually accrete. This may impede water discharge and contribute to bank overflow conditions. In conjunction with the stabilization of eroding areas, the removal of accumulated sediment deposited through culvert discharge, such as in the Stony Brook Gatehouse area, will improve water quality, in conjunction with BMP's implementation.

Upstream of the Agassiz Bridge, in areas absent of *Phragmites*, the shrub vegetation along the banks of the river is variable. These areas would benefit from indigenous plantings to bolster the area's wildlife habitat value. Similar to the Riverway, the Back Bay Fens suffers from a lack of structural heterogeneity, the result of which is incrementally eliminating species utilization through the colonization of monotypic vegetation. To reiterate the primary thesis of this report, the overall species richness in the ecosystem will continue to decline if this pattern goes unabated. An excellent proving ground for plant species introduction is the lagoon area across from the Museum of Fine Arts. Here the thin shrub layer is comprised of purple loosestrife (*Lythrum salicaria*), false indigo (*Amarpha fruticosa*), and jewelweed (*Impatiens capensis*) can be replaced by a more diverse assemblage of species that provide habitat for an equally diverse number of animals. Planted species can be selected from the Olmsted's historic list to ensure compatibility with the historical restoration of the landscape. In addition, a dense shrub zone in these areas will prevent access to the shoreline by geese.

7. Conclusion

A wildlife habitat evaluation and vegetation assessment of the Emerald Necklace in Boston, Massachusetts was performed by LEC Environmental Consultants, Inc. (LEC). The data were collected as part of the Muddy River restoration project sponsored by the City of Boston Parks and Recreation Department.

The Emerald Necklace offers limited wildlife habitat due to the density and extent of non-native invasive species such as common reed (*Phragmites australis*), Japanese knotweed (*Polygonum cuspidatum*), purple loosestrife (*Lythrum salicaria*) and glossy buckthorn (*Rhamnus frangula*). However, because the Emerald Necklace occupies 3.5 miles of almost continuous green space, species do utilize the area, though the quality of habitat is not high. The natural capacity of the resource areas will be substantially improved by increasing vegetative diversity and water quality. These improvements will create an environment conducive to a wide assemblage of aquatic, amphibian, reptilian, avian and mammalian species, with the ultimate goal to create a strong ecological foundation that leads to a sustainable landscape.

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8.

Appendix A

Species Observations

Species observed are listed by common and latin names. In parentheses following the name of the species is the number of observations over the course of the study period.

WARDS POND**Fish**

Bluegill (*Lepomis macrochirus*) (4)
Large mouth bass (*Micropterus salmoides*) (2)
Pumpkin seed (*Lepomis gibbosus*) (5)

Amphibians

Bull frogs (*Rana catesbeiana*) (6+)

Insects

Damsel fly larvae (6+)
Northern bluet (*Enallagma cyathigerum*) (1)

Spring Pond/Babbling Brook /Nickerson Hill**Fish**

Three-spine stickleback (*Gasterosteus aculeatus*) (2)

Amphibians

Bull frogs (*Rana catesbeiana*) (4)

Insects

Northern bluet (*Enallagma cyathigerum*) (1)

Mammals

Eastern chipmunk (*Tamias striatus*) (6+)
Eastern cottontail (*Sylvilagus floridanus*) (1)
Eastern grey squirrel (*Sciurus carolinensis*) (6+)

Birds

Least flycatcher (*Empidonax minimus*) (2)
Northern cardinal (*Cardinalis cardinalis*) (6)
Red-eyed vireo (*Vireo olivaceus*) (1)
Tufted titmouse (*Baeolophus bicolor*) (3)
Yellow warbler (*Dendroica petechia*) (3)

Willow Pond**Fish**

Three-spine stickleback (*Gasterosteus aculeatus*) (1)

Leverett Pond**Fish**

American eel (*Anguilla rostrata*) (3)
Bluegill (*Lepomis macrochirus*) (6+)
Goldfish (*Carassius spp.*) (5)
Large mouth bass (*Micropterus salmoides*) (2)
Golden shiner (*Notemigonus crysoleucas*) (6+)
Pickerel (*Esox spp.*) (4)
Pumpkin seed (*Lepomis gibbosus*) (6+)
Yellow perch (*Perca flavescens*) (4)

Reptiles

Painted turtle (*Chrysemys picta*) (6)
Snapping turtle (*Chelydra serepentina*) (1)

Birds

American Crow (*Corvus brachyrhynchos*) (6+)
American Goldfinch (*Carduelis tristis*) (3)
American Robin (*Turdus migratorius*) (3)

Baltimore Oriole (*Icterus galbula*) (1)
Canada Goose (*Branta canadensis*) (6+)
Cedar Waxwing (*Bombocilla cedrorum*) (3)
Common Grackle (*Quiscalus quiscula*) (4)
Double-crested cormorant (*Phalacrocorax auritus*) (3)
Eastern Kingbird (*Tyrannus tyrannus*) (3)
English Sparrow (*Passer domesticus*) (6+)
European Starling (*Sturnus vulgaris*) (6+)
Gray Catbird (*Dumetella carolinensis*) (5)
Herring Gull (*Larus argentatus*) (6+)
Mallard (*Anas platyrhynchos*) (6+)
Mourning Dove (*Zenaidura macroura*) (6)
Northern Cardinal (*Cardinalis cardinalis*) (5)
Northern Mockingbird (*Mimus polyglottos*) (5)
Pigeons (*Columba spp.*) (6+)
Red-winged Blackbird (*Agelaius phoeniceus*) (6+)
Tree Swallow (*Ichneutes bicolor*) (3)

RIVERWAY**Birds**

American Crow (*Corvus brachyrhynchos*) (6+)
 American Robin (*Turdus migratorius*) (6+)
 Black and White Warbler (*Mniotilta varia*) (1)
 Blue Jay (*Cyanocitta cristata*) (3)
 Canada Goose (*Branta canadensis*) (6+)
 Common Grackle (*Quiscalus quiscula*) (6+)
 Downy Woodpecker (*Picoides pubescens*) (2)
 English Sparrow (*Passer domesticus*) (6+)
 European Starling (*Sturnus vulgaris*) (6+)
 Mallard (*Anas platyrhynchos*) (6+)
 Mourning Dove (*Zenaida macroura*) (6+)
 Red-winged Blackbird (*Agelaius phoeniceus*) (6+)
 Northern Cardinal (*Cardinalis cardinalis*) (3)
 Rock Dove (*Columba livia*) (6+)
 Wood Duck (*Aix sponsa*) (1)

BACK BAY FENS**Fish**

American eel (*Anguilla rostrata*) (3)
 Bluegill (*Lepomis macrochirus*) (6+)
 Common carp (*Cyprinus carpio*) (6+)
 Goldfish (*Carassius spp.*) (6+)
 Large mouth bass (*Micropterus salmoides*) (2)
 Golden shiner (*Notemigonus crysoleucas*) (6+)
 Pumpkin seed (*Lepomis gibbosus*) (6+)
 Yellow perch (*Perca flavescens*) (6+)

Reptiles

Painted Turtle (*Chrysemys picta*) (4)
 Pond Slider (*Chrysemys scripta*) (2)

Birds

American Crow (*Corvus brachyrhynchos*) (6+)
 American Robin (*Turdus migratorius*) (6+)
 Black-capped Chickadee (*Parus atricapillus*) (6+)
 Black and White Warbler (*Mniotilta varia*) (1)
 Blue Jay (*Cyanocitta cristata*) (6+)
 Common Grackle (*Quiscalus quiscula*) (6+)
 European Starling (*Sturnus vulgaris*) (6+)
 Gray Catbird (*Dumetella carolinensis*) (6+)
 Great Blue Heron (*Ardea herodias*) (1)
 Green Heron (*Butorides v. virescens*) (1)
 Herring Gull (*Larus argentatus*) (6+)
 English Sparrow (*Passer domesticus*) (6+)
 Mallard (*Anas platyrhynchos*) (6+)
 Mourning Dove (*Zenaida macroura*) (6+)
 Red-winged Blackbird (*Agelaius phoeniceus*) (6+)
 Rock Dove (*Columba livia*) (6+)

Song Sparrow (*Melospiza melodia*) (3)
 Tree Swallow (*Tachycineta bicolor*) (1)
 Tufted Titmouse (*Parus bicolor*) (1)
 Yellow Throated Warbler (*Dendroica dominica*) (1)